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September 10, 2015

Ms. Michelle Kaysen
USEPA Region 5, Mail Code LU-9J
77 West Jackson Boulevard
Chicago, IL 60604

RE: Draft Additional Light Non-Aqueous Phase Liquid Recovery Pilot Test Summary Report, Hartford Petroleum Release Site, Hartford, Illinois

Ms. Kaysen:

On behalf of Apex Oil Company, Inc. (Apex), Trihydro Corporation (Trihydro) is submitting the draft *Additional Light Non-Aqueous Phase Liquid Recovery Pilot Test Summary Report, Hartford Petroleum Release Site, Hartford, Illinois* to the United States Environmental Protection Agency (USEPA) and Illinois EPA for review. Focused pumping resumed on January 9, 2015 and continued through March 10, 2015. The report provides a summary of the resumed pilot test and has been prepared in accordance with the *Final LNAPL Recovery Pilot Test Work Plan Addendum* (Trihydro 2013).

If you have questions regarding the summary report, please contact Paul Michalski at (513) 429-7452.

Sincerely,
Trihydro Corporation

Paul Michalski, P.G.
Team Leader

24S-003-004

Attachments

cc: James Sanders, Apex Oil Company, Inc.
Tom Miller, Illinois Environmental Protection Agency
Chris Cahnovsky, Illinois Environmental Protection Agency
Conor Neal, United States Environmental Protection Ageny
Jody Edwards, Tetra Tech, Inc.

DRAFT

ADDITIONAL LIGHT NON-AQUEOUS PHASE LIQUID RECOVERY PILOT TEST SUMMARY REPORT HARTFORD PETROLEUM RELEASE SITE HARTFORD, ILLINOIS

September 10, 2015

Project #: 24S-003-004

PREPARED BY: Trihydro Corporation

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Table of Contents

1.0 INTRODUCTION 1-1
- 1.1 Background 1-1
  - 1.1.1 LNAPL Recoverability under Confined Conditions 1-2
    - 1.1.1.1 Pilot Testing in Area A under Confined Conditions 1-3
  - 1.1.2 LNAPL Recoverability under Unconfined Conditions 1-4
- 1.2 Purpose 1-4

2.0 PILOT TEST INFRASTRUCTURE 2-1
- 2.1 Piezometer Installation 2-1
  - 2.1.1 Lithology 2-2
  - 2.1.2 Soil Quality Analytical Results 2-2
- 2.2 Groundwater Recovery and Temporary Treatment System 2-4
- 2.3 LNAPL Recovery and Storage 2-5

3.0 TREATMENT SYSTEM OPERATIONS, MAINTENANCE, AND MONITORING 3-1
- 3.1 Agreements and Permits 3-1
- 3.2 Resumed Pilot Test Start Up 3-2
- 3.3 Remote Fluid Level Monitoring in Combined Sewer Overflow 3-3
- 3.4 Temporary Treatment System Operation 3-3
- 3.5 Treatment System Compliance Monitoring 3-4
- 3.6 Ambient Air Monitoring 3-5
- 3.7 Focused Pumping Termination and System Decommissioning 3-6

4.0 PILOT TEST RESULTS 4-1
- 4.1 Baseline Fluid Level Monitoring 4-1
- 4.2 Short-term Step Test 4-2
- 4.3 Long-term Focused Pumping Test 4-4
  - 4.3.1 Mississippi River Elevations 4-4
  - 4.3.2 Groundwater Elevations in Main Sand Stratum 4-5
  - 4.3.3 Corrected Drawdown during Focused Pumping 4-5
  - 4.3.4 Radius of Influence 4-6
  - 4.3.5 Transmissivity and Hydraulic Conductivity 4-6
- 4.4 LNAPL Occurrence in Area A 4-7

Table of Contents (cont.)

4.4.1 LNAPL Transmissivity 4-8

4.5 Vapor Phase Recovery 4-9

4.6 Dissolved Phase Monitoring 4-10

5.0 CONCLUSIONS 5-1

5.1 Effective Drawdown and Exposure of LNAPL Smear Zone 5-1

5.2 LNAPL and Volatile Hydrocarbon Recovery 5-1

5.3 Path Forward 5-3

6.0 REFERENCES 6-1

List of Tables

1a. Soil Analytical Results Summary, Volatile Petroleum Related Constituents

1b. Soil Analytical Results Summary, Semivolatile Petroleum Related Constituents

1c. Soil Analytical Results Summary, Total Petroleum Hydrocarbons

1d. Soil Physical Properties Results Summary

2. LNAPL Saturation Estimates

3a. Groundwater Treatment Compliance Monitoring Analytical Results, Volatile Petroleum Related Constituents, Metals, and General Water Quality Parameters

3b. Groundwater Treatment Compliance Monitoring Analytical Results, Semivolatile Petroleum Related Constituents

4. Groundwater Treatment System Operations Summary

5. Ambient Air Monitoring Analytical Results Summary

6. Performance Monitoring Summary

7. Step-Test Results Summary

8. Area A Manual Fluid Level Measurements and Corrected Drawdown

9. Soil Vapor Extraction Screening Results Summary

10. Groundwater Analytical Results Summary

List of Figures

1. Site Location Map
2. Schematic Diagram of Dual Optimal LNAPL Response Model
3. Pilot Test Treatment Train Schematic
4. Treatment and Recovery Infrastructure Layout
5. Area A Trigger Monitoring Well Hydrographs
6. River Stage Elevation and Daily Precipitation
7. Hydrographs of Pressure Transducer Results from Select Monitoring Locations
8. Step Test Results
9. Hydrographs of Manual Measurements from Select Monitoring Locations
10. Potentiometric Surface Map, Main Sand Hydrostratigraphic Unit (March 2015)
11. Uncorrected and Corrected Drawdown for Select Monitoring Locations
12. Drawdown versus Distance from Production Well HPW-01
13. Time-Drawdown Analysis from Select Monitoring Locations
14. Volatile Petroleum Hydrocarbon Recovery Rate Compared to Hydrograph for Monitoring Point MP-135
15. Ranked Areas Representing Total Hydrocarbon Concentrations in Shallow Soil Gas (January 2015)
16. Ranked Areas Representing Total Volatile Petroleum Hydrocarbon Concentrations in Soil Vapor Extraction Wells During Low Water Table (October 2012)
17. Ranked Areas Representing Benzene Concentrations in Groundwater (2011-2013)
18. Ranked Areas Representing LNAPL Thickness in Monitoring Wells (March 2015)
19. Composite of All Ranked Area Figures Representing Areas of Greatest Concern

List of Appendices

A. WELL COMPLETION CONSTRUCTION DIAGRAMS FOR PIEZOMETERS

B. PIEZOMETER BORING ANALYTICAL REPORTS

C. ILLINOIS EPA DIVISION OF WATER MODIFIED PERMIT OF CONSTRUCTION/OPERATION APPROVAL (PERMIT NO. 2014-EE-58312-1)

D. TEMPORARY TREATMENT SYSTEM COMPLIANCE ANALYTICAL REPORTS

E. AMBIENT AIR MONITORING ANALYTICAL REPORTS

F. PRESSURE TRANSDUCER MEASUREMENTS

G AQTESOLV™ AQUIFER TESTING INPUTS AND RESULTS

H. LNAPL BAILDOWN MONITORING RESULTS AND LNAPL DISCHARGE VERSUS DRAWDOWN

I-1. DISSOLVED PHASE MONITORING FIELD FORMS

I-2. DISSOLVED PHASE MONITORING ANALYTICAL REPORTS

1.0 INTRODUCTION

Pursuant to a unilateral Administrative Order issued by the United States Environmental Protection Agency (USEPA) on July 20, 2010, Apex Oil Company, Inc. (Apex) completed additional light non-aqueous phase liquid (LNAPL) recovery pilot testing within Area A of the Hartford Petroleum Release Site (Hartford Site). Area A includes a small portion of the Hartford Site located on North Olive Street between East Forest and East Elm Streets, and does not extend beyond the rights-of-way for the Norfolk and Western, Union Pacific, Kansas City Southern, and Norfolk Southern Railroads (Figure 1). The most recent pilot testing activities under this order involved focused groundwater pumping at a rate of up to 320 gallons per minute (gpm) during unconfined groundwater conditions (groundwater generally below 400 feet above mean sea level [ft-amsl] beneath Area A).

Initially, focused pumping began on March 8, 2014 but was discontinued prior to completion of the test on April 2, 2014 due to several significant rainfall events resulting in nearly four inches of precipitation over a three-day period. In accordance with groundwater elevation triggers, focused pumping was resumed on January 9, 2015 and continued through March 10, 2015. Prior to each of the focused pumping events, infrastructure for groundwater extraction and treatment, as well as LNAPL recovery and storage were installed within Area A. The pilot test infrastructure, as well as operation, maintenance, and monitoring activities are described in the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a). A summary of the 2014 partial pilot test results were described within the *Final Additional Light Non-Aqueous Phase Liquid Recovery Partial Pilot Test Summary Report* (Trihydro 2014b). This report provides a summary of the resumed pilot test completed in the first quarter of 2015.

1.1 BACKGROUND

The Dual Optimal LNAPL Response (DOLR) conceptual model was developed (H2A 2006) to explain the occurrence and potential recoverability of LNAPL under various hydraulic conditions. The DOLR model applies to the LNAPL present in the Main Sand stratum, where the water table periodically transitions from unconfined to confined conditions. The DOLR model might also be applicable to shallower permeable strata such as the Rand and Main Silt, where LNAPL transitions between unconfined and confined conditions. However, as described in the *Revised LNAPL Component to the Conceptual Site Model* (Trihydro 2014a), LNAPL is detected infrequently in monitoring locations screened within these strata, suggesting that the fraction of total LNAPL that is potentially mobile and recoverable is relatively low. Therefore, the DOLR model is most useful in conceptualizing LNAPL recovery within the Main Sand, where the majority of LNAPL appears to be present beneath the Hartford Site (Trihydro 2014a).

LNAPL, when present, shares available pore space between sediment grains with water and air. In order for LNAPL to be mobile and recoverable, it needs to be continuous or connected within the pore spaces. Within the saturated zone, where the pore spaces are primarily filled with water, LNAPL is generally present as less connected globules within the smaller pore spaces (2-phase conditions). That is, while some of the LNAPL might be connected and potentially capable of mobilizing to a well, much of it is often present as separate ganglia due to the majority of pore space being filled with water. Within the capillary fringe and vadose zone where water content is lower and air is also present (3 phase conditions), LNAPL tends to be more connected within the larger pore spaces. Put another way, LNAPL residual saturation can vary depending on whether 2-phase or 3-phase conditions are present (Charbeneau 2007). When LNAPL saturations are high and/or water saturations are low, LNAPL is better connected and therefore potentially mobile (i.e., the LNAPL is above the residual saturation). LNAPL preferentially moves within coarse-grained sediments such as sand and gravel (i.e., lower pore entry pressure), and is less able to migrate through fine-grained sediments such as silt and clay (assuming similar water content within the pore space).

1.1.1 LNAPL RECOVERABILITY UNDER CONFINED CONDITIONS

The first part of the DOLR model states that under confining conditions (created when groundwater within the Main Sand stratum intercepts and is forced against overlying finer-grained stratum), hydrostatic forces drive LNAPL into wells that behave essentially as pressure relief points. This is schematically depicted in the first panel on Figure 2. As the water table rises, some LNAPL in the smear zone also rises within connected pore spaces between the coarse-grained sediments and eventually contacts the bottom of the overlying fine-grained stratum. Increases in the piezometric surface are directly proportional to increasing LNAPL thicknesses, as the LNAPL remains confined against the overlying fine-grained stratum and unable to displace water from the smaller pore spaces. Although the LNAPL is unable to move any further vertically, it is able to move laterally along the contact of the coarser Main Sand and overlying fine-grained stratum. This potential for lateral movement is limited under these confined conditions because any portion of the pore space not occupied by LNAPL tends to be filled with water (2-phase conditions). Still, if a well is screened across the contact of the confining stratum and the Main Sand, some fraction of LNAPL can move laterally into the well. Such a condition could mean relatively high initial LNAPL recoverability from the well if mobile LNAPL can collect at the base of the confining layer and water in the well does not exert a significant backpressure. However, under this condition the "mass of available mobile LNAPL is minimal since much of the LNAPL mass is trapped underneath this high water table" (p. 59 of Appendix E within the *Active LNAPL Recovery System 90% Design Report* [Clayton 2006]). As LNAPL is removed from the formation adjacent to the well, LNAPL saturations may decrease as water saturations increase, resulting in reduced recoverability. Only if LNAPL in the vicinity of the recovery well remains above residual saturations (i.e., has sufficient connectivity in this 2-phase condition) would recovery remain sustainable.

1.1.1.1 PILOT TESTING IN AREA A UNDER CONFINED CONDITIONS

Pilot testing of LNAPL recoverability under confining conditions was performed by WSP Environmental & Energy (WSP) in Area A between October 2011 and January 2012 (the WSP pilot test) with the primary objective of evaluating previously selected technologies for LNAPL recovery including soil vapor extraction (SVE), multiphase extraction (MPE), and dual phase extraction (DPE). As described in *the Light Non-Aqueous Phase Liquid Recovery Pilot Test Interim Report* (WSP 2012), groundwater and LNAPL were confined within the test well MPE-A001 throughout most of the WSP pilot test. Well MPE-A001 is located in Area A and screened across the top of the Main Sand Stratum. Immediately prior to testing, the LNAPL thickness in well MPE-A001 was 3.24 feet, greater than that typically observed in this well under unconfined conditions, which is consistent with exaggerated LNAPL thicknesses observed in many of the wells under confined conditions across the Hartford Site (Trihydro 2014a).

The LNAPL-water interface was present within the screened interval of the well. However, once a vacuum was induced on well MPE-A001 to evaluate SVE, the screened interval became submerged (also referred to as occluded). MPE was tested on November 7 through November 10, 2011. A drop tube was placed in the well with an applied vacuum for three hours the first day and nearly continuous thereafter. The drop tube diameter and elevation were varied during the testing, and airflow ranged from 13 standard cubic feet per minute (scfm) to 85 scfm. The applied vacuum achieved removal of fluids from well MPE-A001 with a maximum drawdown of 2.2 feet, but did not lower the fluid levels to below the top of the screen. Although an exaggerated LNAPL thickness was measured prior to testing, no measurable LNAPL recovery was achieved during the test. Instead, approximately 6,900 gallons of groundwater were extracted.

Pilot testing of DPE was planned, but based on the lack of significant drawdown during pilot testing of MPE, a pumping test was performed instead to assess achievable drawdown within the test well. Following a step test, a constant rate pump test was conducted at 20 gpm for 6.5 hours. Approximately 9 feet of drawdown was observed in the test well, exposing approximately 8 feet of the well screen. However, the LNAPL thickness in the well decreased from 2.89 feet to 0.14 feet during the pump test. Fluid level monitoring within the nearby wells indicated some influence within 50 feet of the test well, but LNAPL thicknesses did not increase in any of the surrounding wells during the pump test.

Overall, the pilot test resulted in no measureable LNAPL recovery using MPE, and insufficient drawdown in the well to expose the screen. Additionally, groundwater pumping did not affect LNAPL thickness in the test or nearby monitoring wells over the 6.5-hour pump test duration. The results suggested that MPE is not sufficient to achieve LNAPL recovery in Area A under confined conditions.

However, transmissivity testing conducted in October 2011 during confined conditions and in January 2012 during unconfined conditions indicated an increase in transmissivity from 0.0005 and 0.04 square feet per day to 0.02 and 0.09 square feet per day, respectively. The increase in transmissivity, observed as the ambient water table decreased, suggested that pumping under unconfined conditions might be a viable approach for additional LNAPL recovery in Area A.

1.1.2 LNAPL RECOVERABILITY UNDER UNCONFINED CONDITIONS

The second part of the DOLR model states that under unconfined conditions, LNAPL can vertically drain from the coarse-sediments within the Main Sand as the water table falls below the confining strata. Under intermediate unconfined conditions (i.e., when the aquifer is unconfined but the water table is still relatively high), LNAPL thicknesses in wells can be relatively low because the confining pressure is no longer present and "much of the LNAPL is still submerged and entrapped under the water table" (p. 60 of Appendix E within the *Active LNAPL Recovery System 90% Design Report* [Clayton 2006]). A small fraction of available LNAPL will subsequently accumulate above the water table, as depicted in the second panel on Figure 2.

If the water table decreases further, "much of the submerged residual LNAPL drains from the Main Sand, (and) larger volumes of mobile LNAPL are available to accumulate in wells" (p. 60 of Appendix E within the *Active LNAPL Recovery System 90% Design Report* [Clayton 2006]). Under this model, the further the water table falls, the more LNAPL drains and accumulates near the water table and LNAPL could move laterally more easily within the Main Sand. If the screen interval within a well intersects the mobile LNAPL interval and the water table is sufficiently low for a sustained period, LNAPL could enter it and have an elevation that is consistent with the vertical interval of recoverable LNAPL in the formation (i.e., no exaggerated thickness). As shown on the third panel on Figure 2, sustained LNAPL recovery may be attainable under these lower water table conditions due to a larger mass of mobile LNAPL present under 3 phase conditions (i.e., unsubmerged) and therefore potentially recoverable. Historical recovery modeling performed using soil cores collected in Area A has ignored LNAPL that is typically submerged in the Main Sand stratum (Trihydro 2014a). In addition, pilot testing using an approach to expose mobile LNAPL that is typically submerged had not been performed at the Hartford Site and remained a data gap with respect to recoverability.

1.2 PURPOSE

As described in the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a), the purpose of the additional pilot test was to enhance exposure of the LNAPL smear zone within the Main Sand stratum, located between 385 and 400 ft-amsl (approximately 30 to 45 feet below ground surface [ft-bgs]) in Area A. It was anticipated that exposing deeper portions of the smear zone could increase LNAPL transmissivity and mobility; therefore, enhancing recovery of LNAPL in Area A. Exposing the deeper portions of the smear zone could also facilitate increased vapor recovery and smear zone mass depletion through the existing SVE system. The pilot test was designed to evaluate the extent to which focused pumping could: (1) sustain unconfined conditions, (2) expose additional portions of the smear zone, and (3) allow recovery of mobile LNAPL and volatile petroleum hydrocarbons present in the Main Sand stratum beneath Area A. The remainder of this report is organized into the following sections:

- Section 2.0 – Describes the design and installation of the infrastructure necessary to complete the resumed pilot test in Area A of the Hartford Site.
- Section 3.0 – Discusses the operations and maintenance of the temporary groundwater treatment system, including start-up and shutdown, as well as compliance monitoring results.
- Section 4.0 – Provides an analysis of the resumed pilot test results including evaluation of hydraulic conditions, vapor phase mass recovery, and dissolved phase conditions beneath Area A.
- Section 5.0 – Includes an evaluation of the effectiveness of focused pumping, LNAPL recoverability, and a conceptual framework for future pilot testing and multiphase remedy design.

2.0 PILOT TEST INFRASTRUCTURE

Prior to re-initiating focused pumping, additional infrastructure was installed by Apex in Area A of the Hartford Site. A detailed summary of the infrastructure installed prior to the partial pilot test (e.g., groundwater production well, LNAPL recovery well, and discharge conveyance line to the Village of Hartford combined sewer system) was provided within the *Additional Light Non-Aqueous Phase Liquid Recovery Partial Pilot Test Summary Report* (Trihydro 2014a). Additional infrastructure installed and constructed to support the resumed pilot test (e.g., piezometers, temporary groundwater treatment system, LNAPL collection system) conducted in the first quarter of 2015 is provided in this section.

2.1 PIEZOMETER INSTALLATION

Three 2-inch diameter groundwater piezometers (PZ-01, PZ-02, and PZ-03) were installed to: (1) estimate LNAPL saturations in soil present in the smear zone in the vicinity of groundwater production well HPW-01 and LNAPL recovery well HLRW-01 and (2) evaluate drawdown and hydraulic response within the Main Sand during focused pumping. The three piezometers were installed within 10 feet of groundwater production well HPW-01 and LNAPL recovery well HLRW-01 (Figure 1) by Roberts Environmental Drilling, Inc. between October 27 and 29, 2014. A 6-inch diameter boring was installed using a hollow stem drilling methodology to a total depth of 45 ft-bgs at the three piezometer locations. Continuous cores were collected from each boring, logged by a geologist, and field screened for total organic vapors to the total depth. Soil samples were collected from select intervals within the LNAPL smear zone in the Main Sand stratum and submitted for laboratory analysis. A description of the lithology recorded during installation of the borings is provided in Section 2.1.1 and a summary of the soil analytical results is included in Section 2.1.2.

Following installation of each boring, 2-inch diameter, 0.010-inch continuously slotted, polyvinyl chloride (PVC) screen was installed across the upper portion of the Main Sand stratum (coincident with the smear zone) from approximately 30 to 45 ft-bgs, and 2-inch blank PVC casing was installed from 30 ft-bgs to approximately 0.5 ft-bgs. Sections of screen and casing were connected via flush threaded joints. A No. 10/20 sand filter pack was then placed within the annulus of the boring from approximately 25 to 45 ft-bgs. A 5-feet thick bentonite seal was placed from the top of the sand pack to approximately 20 ft-bgs. The bentonite seal was installed and hydrated in 6-inch lifts. A 95% concrete and 5% bentonite grout was emplaced from the top of the seal to approximately 1 ft-bgs. The piezometers were completed within 18-inch flush mounted, traffic rated vaults set into an approximate 6-inch thick concrete pad. The construction diagrams for the three piezometers installed in Area A are provided in Appendix A.

On October 30, 2014, each of the newly installed piezometers was developed by first bailing out any sediments, which accumulated during installation and then overpumping the well at a maximum rate of 10 gpm. That same day, LNAPL recovery well HLRW-01 was redeveloped by overpumping the screened portion of the well at a maximum pumping rate of 100 gpm. Approximately 2,500 gallons of groundwater were pumped from the newly installed piezometers and LNAPL recovery well and stored within a steel frac tank temporarily located at 309 North Olive Street. Following characterization, the groundwater was removed by Environmental Management Alternatives, Inc. and treated at the Bissell Point Wastewater Treatment Plant, which is managed by the Metropolitan St. Louis Sewer District.

2.1.1 LITHOLOGY

The lithology recorded during the installation of the three piezometers was generally consistent with one another, as well as previous borings installed in Area A, consisting of alternating fine-grained alluvial deposits of clay and silt separating coarser grained hydrostratigraphic units. Specifically, the A Clay was present from ground surface to approximately 11 ft-bgs and consists of moderate to low plasticity silts and clays. The North Olive stratum, composed primarily of fine-grained sand with silt, underlies the A Clay and is located from approximately 11 to 15 ft-bgs. The B Clay present from approximately 15 to 19 ft-bgs is comprised of high plasticity silts and clays. The Rand stratum, composed of fine sands and silt, is present between approximately 19 and 24 ft-bgs. The C Clay situated at approximately 24 to 29 ft-bgs separates the Rand and Main Sand strata. The C Clay is composed of dense, low plasticity clays. The Main Sand stratum is present from 29 ft-bgs to the total depth of the boring. The Main Sand primarily consists of fine- to medium-grained, well-sorted sands with lenses of coarse-grained sands and gravels.

2.1.2 SOIL QUALITY ANALYTICAL RESULTS

During installation of each boring, soil samples were collected from four intervals (28-29 ft-bgs, 31-32 ft-bgs, 35-36 ft-bgs, and 40-41 ft-bgs) across the smear zone present in the Main Sand stratum. Soil samples were submitted for laboratory analysis of volatile petroleum related constituents (USEPA Method 8260), semivolatile petroleum related constituents (USEPA 8270), total petroleum hydrocarbons reported as diesel range and gasoline range organics (USEPA Method 8015), and geophysical properties including moisture content and bulk density. A summary of the analytical results for the soil samples collected during installation of the piezometers is provided in Tables 1a through 1d and the laboratory analytical report is included in Appendix B.

The analytical results indicate that LNAPL present in soil consists of elevated concentrations of benzene, ethylbenzene, toluene, xylenes, heptane, hexane, and trimethylbenzene isomers. Semivolatile petroleum hydrocarbons were detected at lower concentrations and primarily composed of naphthalene and 2-methylnaphthalene. The highest concentrations of volatile and semivolatile petroleum related constituents, as well as total petroleum hydrocarbons reported as diesel range and gasoline range organics varied across the three borings. Within the soil core collected from piezometer PZ-01, the highest concentrations of petroleum related constituents were observed in the upper portions of the smear zone; whereas, in soil cores collected from piezometers PZ-02 and PZ-03 the highest concentrations occurred in the lower and the middle portions of the smear zone, respectively. The laboratory analytical results combined with the close proximity of the three piezometers (less than 10 feet) indicate a highly variable LNAPL distribution within the smear zone beneath Area A.

In addition, the total petroleum hydrocarbons reported as diesel range and gasoline range organics were used to estimate the saturation of LNAPL in soil using the following equation (API 2006, Hawthorne 2012):

$$S_n = C_{TPH} \times \frac{\rho_b \times 10^{-6}}{\Phi \rho_n}$$

Where:

S_n = LNAPL Saturation (grams)

C_{TPH} = Concentration of total petroleum hydrocarbons reported as diesel and gasoline range organics (milligram per kilogram)

ρ_b = Soil bulk density (grams per cubic centimeter)

ρ_n = LNAPL density (grams per cubic centimeter)

Φ = total porosity (cubic centimeter per cubic centimeter)

LNAPL saturation estimates for the four soil samples collected from the three borings installed in Area A in October 2014 are provided as Table 2. The saturation estimates for individual samples ranged from 0.31 to 9.04%. The average LNAPL saturation within the upper, middle, and lower portions of the smear zone ranged from 1.79 to 3.69%, with an overall saturation across the smear zone of 2.72%. These estimates are generally below saturations that might be indicative of mobile LNAPL within sands and gravels, similar to the alluvial deposits that make up the Main Sand stratum.

In general, LNAPL saturation estimated from total petroleum hydrocarbon concentrations in soil tend to be more accurate with increasing concentrations of gasoline and diesel range organics, with a suggested lower limit of 5,000 milligrams per kilogram (Hawthorne 2012). As summarized on Table 2, the concentration of total petroleum hydrocarbons reported as diesel and gasoline range organics are similar or below this suggested lower limit. Furthermore, the saturation estimates tend to be more accurate for LNAPL composed predominantly of stable constituents, or in other words, LNAPL with a low mole fraction of volatile and soluble constituents (Hawthorne 2012).

The soil and groundwater analytical results (discussed in Section 4.6) collected in Area A indicate that LNAPL is composed of a high mole fraction of both soluble and volatile constituents.

In addition, LNAPL saturation estimates have a strong correlation with the total porosity. The LNAPL saturation estimates presented on Table 2 were calculated using total porosity reported from depth discrete intervals within an intact soil core collected from soil boring HCSB-01 in September 2005. The 2005 porosity measurements from the intact soil core were reported between 37 and 45% across the smear zone in this portion of Area A. For comparison, total porosity of the non-intact soil samples collected during installation of the piezometers in October 2014 was calculated using the moisture content and bulk density reported by the laboratory (Table 1d). These estimates of total porosity for the non-intact soil samples ranged from 16.9 to 34.7%, with an average moisture content of 25.2%. It appears that some portion of fluid (LNAPL and groundwater) drained from the soil, which likely occurred when: (1) the cores were extracted from the borings during installation, (2) soil samples were collected by the geologist, and (3) aliquots of soil were extracted and prepared for analysis by the laboratory. If the porosity estimates for the non-intact soil samples collected during installation of the piezometers is substituted for the depth specific porosity measurements reported from soil boring HCSB-01, then the range of average LNAPL saturations increases to between 3.29 and 7.32%, with an overall saturation of 4.53% across the smear zone.

Each of these factors (relatively low concentrations of total petroleum hydrocarbons, elevated concentrations of volatile and soluble constituents, as well as fluid loss during sample collection and analysis) may contribute to a low bias in the LNAPL saturation estimates presented herein. Despite these limitations, these LNAPL saturation estimates may represent an important consideration when evaluating the additional LNAPL recovery pilot test results and designing a multiphase remedial framework for the Hartford Site.

2.2 GROUNDWATER RECOVERY AND TEMPORARY TREATMENT SYSTEM

Similar to the partial pilot test performed in 2014, a 6-inch diameter, 15-horsepower submersible pump (Grundfos 300S) was used with 4-inch galvanized steel threaded riser pipe to recover groundwater from production well HPW-01. The submersible pump was connected to a variable frequency drive (VFD) installed within the master control panel. The VFD allowed adjustments to the pumping rates needed to complete the short-term step test (Section 4.2). The pump had a nominal flow rate of 300 gpm, and the pump intake was set within the sump of the production well, below the screened interval, at approximately 70.5 ft-bgs (360.4 ft-amsl). A pressure transducer was attached to the riser pipe at approximately 51 ft-bgs to monitor groundwater levels during the step test and focused pumping. Four-inch diameter flexible hoses with cam and groove fittings affixed to the riser pipe conveyed water from groundwater production well HPW-01 to the temporary groundwater treatment system.

As shown conceptually on Figure 2 and in detail on Figure 3, recovered groundwater from the production well was first transferred into a 21,000-gallon frac tank. This first frac tank allowed settling of entrained sediments in the recovered groundwater. A transfer pump (Goulds 3656-M) conveyed the groundwater from this first frac tank to a second 21,000-gallon frac tank to promote additional settling of sediments. An additional transfer pump (Goulds 3656-S) moved recovered water from the second frac tank into a series of four 10-micron bag filters to capture any remaining suspended particulates. Following filtration, groundwater was conveyed through a series of two 10,000-pound vessels containing granular activated carbon (GAC) to adsorb dissolved phase petroleum related constituents.

In order to conduct compliance monitoring of the treatment system effectiveness (described in Section 3.4), three sample ports were installed. The first sample port (SP-00) was installed after the final bag filter to allow collection of an untreated (influent) groundwater sample. Two additional sample ports (SP-01 and SP-02) were installed at the base of each treatment vessel to assess breakthrough of dissolved phase constituents through the primary GAC vessel and prior to discharge to the Village of Hartford combined sewer system (CSS). The second sample port, SP-02, was monitored to ensure treated groundwater was below the Illinois Environmental Protection Agency (Illinois EPA) Division of Water, Village of Hartford CSS, and Wood River Wastewater Treatment Plan (WRWTP) permitted effluent limits.

As required by the Illinois EPA Division of Water, a photoionization detector (PID) was installed at the point of connection between the discharge line and the 21-inch sewer main beneath North Market Avenue. The PID was installed to measure the percent of the lower explosion limit (%LEL) in the headspace of the treated water being discharged into the sewer main. The results of the PID were displayed on the master control panel located at 311 North Olive Street, and the treatment system was configured to shut down in the event that the LEL exceeded 10% in the headspace of the sewer main.

2.3 LNAPL RECOVERY AND STORAGE

Two Clean Earth Technology, Inc. Magnum Spill Busters™ were installed within LNAPL recovery well HLRW-01 to extract and convey LNAPL to the storage tanks located south of 309 North Olive Street. The Spill Buster skimmer pumps employ an auto-seeking device that automatically adjusts the pump intake to the elevation of the LNAPL-water interface as it fluctuates. As shown on Figure 3, two 1,000 gallon, double-walled storage tanks (Modern Welding Company Ultra Lube Cube®, which provide UL-listed integral secondary containment) were positioned within the wooden privacy fence south of 309 North Olive Street and installed in accordance with Illinois State Fire Marshal requirements (e.g., appropriate offset distances from structures and roadways). The LNAPL storage tanks were inspected on March 6, 2014 by the Village of Hartford Fire Chief.

3.0 TREATMENT SYSTEM OPERATIONS, MAINTENANCE, AND MONITORING

Between December 30, 2014 and January 2, 2015, the temporary groundwater treatment system components were mobilized and positioned onto the gravel pad that was placed to the north of 309 North Olive Street. Transducers were installed within the frac tank, weir tank, and treatment vessels and the final electrical connections were made from the control panels to the submersible pump, transfer pumps, and transducers. In addition, the Spill Buster skimmer pumps were installed within LNAPL recovery well HLRW-01, high level switches were installed in the LNAPL storage tanks, and the plumbing and electrical connections were completed between the control panel, recovery well, and LNAPL storage area. Finally, temporary plumbing connections were completed between the submersible pump and treatment system components. On December 31, 2014, the first batch of groundwater was extracted and treated to determine the effectiveness of the temporary groundwater treatment system prior to discharging water into the Village of Hartford CSS and eventually the WRWTP.

3.1 AGREEMENTS AND PERMITS

A September 16, 2013 agreement with the City of Wood River described the purpose and duration of the pilot test, rates of groundwater extraction during focused pumping, treatment of the extracted groundwater, compliance monitoring of the temporary treatment system, and triggers for discontinuing the focused pumping pilot test. In addition, this agreement established user rates for treatment of water at the WRWTP. On October 9, 2014, an amendment to the agreement was executed, allowing Apex to resume the pilot test, as well as increase the maximum flow rate from 300 gpm to 350 gpm during focused pumping.

A separate agreement with the Village of Hartford dated September 24, 2013, established prior to the commencement of construction activities, consented to the installation of the treatment system infrastructure including a 6-inch pipeline and provided access to the rights of way maintained by the Village of Hartford. This agreement also established operational limits for focused pumping (i.e., duration and shutdown criteria), as well as payment terms for discharging treated water into the Village of Hartford CSS. In an October 23, 2013 addendum to this agreement, the Village of Hartford provided Apex a permanent easement for the discharge line with specific provisions for reverting line ownership back to the Village of Hartford under certain circumstances. An additional amendment dated September 24, 2014 allowed Apex to resume the additional LNAPL recovery pilot test in Area A at an increased flow rate of 350 gpm. In order to accommodate the increased discharge rate, Apex agreed to install a real-time remote fluid level transducer and telemetry system within the combined sewer overflow weir near the intersection of Old St. Louis Road and West Hawthorne Street. The remote monitoring equipment provided an early warning to prevent fluids in the Village of

Hartford sewer system (including sewage, storm water, and treated groundwater) from discharging directly into the Mississippi River (referred to as a combined sewer overflow event). Furthermore, within this amendment, Apex assumed sole responsibility of payment and fines levied against the Village of Hartford should a combined sewer overflow event occur during the resumed pilot test in Area A.

In addition, the Village of Hartford and City of Wood River provided consent to resume pilot test activities by signing the Application for Permit of Construction/Operation Approval (Application) dated November 17, 2014. The Application requested minor modifications to Permit No. 2014-EE-58312 issued by the Illinois EPA Division of Water on January 23, 2014, including an increase in the maximum pumping rate from 300 to 350 gpm, changes in the groundwater treatment infrastructure, and performing real-time monitoring of fluid levels within the Village of Hartford combined sewer overflow weir. The requested minor modifications were granted by the Illinois EPA Division of Water via issuance of Permit No. 2014-EE-58312-1 on February 10, 2015. A copy of the modified permit is provided in Appendix C.

3.2 RESUMED PILOT TEST START UP

As described in the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a), focused pumping would only be capable of exposing additional portions of the LNAPL smear zone within the Main Sand stratum when groundwater conditions are unconfined (groundwater generally below 400 ft-amsl beneath Area A). In order to track groundwater conditions in Area A, fluid level measurements were gauged weekly within three trigger wells (ASW-003, HMW-044C, and MPE-A003). Focused pumping could only proceed when ambient groundwater elevations were below the 400 ft-amsl trigger elevation in at least two of the three trigger wells. As depicted on Figure 5, groundwater elevations were below 400 ft-amsl in all three trigger wells beginning on December 11, 2014 and remained so through the duration of the resumed pilot test.

On December 31, 2014, an initial 5,000-gallons of groundwater were extracted from production well HPW-01 and processed within the temporary treatment system installed in Area A in order to confirm the adequacy of treatment prior to discharging water to the Village of Hartford CSS. In order to treat this first batch of groundwater, the system was reconfigured so that extracted groundwater was pumped directly through the bag filters and GAC vessels with the treated discharge routed to the primary frac tank for temporary storage. Treated groundwater samples were collected from sample port SP-02 (following treatment through the two GAC vessels) and submitted to Teklab, Inc. for expedited analysis of volatile petroleum related constituents via USEPA Method 8260, polycyclic aromatic hydrocarbons (PAHs) via USEPA Method 8270, oil and grease using USEPA Method 1664A, dissolved arsenic and lead via USEPA Method 6020, chemical oxygen demand (COD) by USEPA Method EPA 410.4, and biological oxygen demand (BOD) by Standard Method 5210B. The analytical results for this first batch of treated water including a comparison to the effluent limits are provided on Tables 3A and 3B. The analytical reports provided by the laboratory are included in Appendix D.

Upon receipt of the analytical results demonstrating that the temporary treatment system was effective at reducing concentrations in extracted groundwater below the effluent limits, the first batch of treated water stored within the frac tank was discharged to the Village of Hartford CSS. Following the conclusion of the batch test, the treatment system was reconfigured for continuous operation.

3.3 REMOTE FLUID LEVEL MONITORING IN COMBINED SEWER OVERFLOW

On January 9, 2015, prior to the start of step testing, a real-time remote fluid level monitoring system (consisting of a pressure transducer, data logger, and telemetry equipment) was installed within the manway accessing the Village of Hartford combined sewer overflow weir near the intersection of Old St. Louis Road and West Hawthorne Street. The data logging and telemetry equipment was installed within a 14-inch by 18-inch by 6-inch junction box on the interior of the manway. The pressure transducer was installed within 1-inch-diameter PVC casing terminating at the invert of the sewer pipe. The PVC casing was anchored to the side of the manway and used to protect the transducer from debris flowing through the sewer. Finally, a cellular antenna was affixed near the top of the manhole immediately below the manhole cover. The existing cast-iron manhole cover was replaced with a composite cover to facilitate cellular transmission from below street grade. A computer was connected to the telemetry equipment and the system was calibrated (based on the measured fluid level and overflow weir elevation). The system was then remotely programmed to provide an emergency call to key site personnel upon exceedance of a threshold fluid level corresponding to 0.2-feet of freeboard (i.e., call outs occurred when the water level was within 0.2 feet of the top of the overflow weir). Periodically during focused pumping, site personnel adjusted the rate at which treated groundwater was discharged into the sewers from the temporary treatment system based upon alarm notifications and inspection of fluid levels within the combined sewer overflow.

3.4 TEMPORARY TREATMENT SYSTEM OPERATION

Pumping commenced on January 9, 2015 with a short-term step test consisting of discrete pumping rates ranging from approximately 50 to 300 gpm. Pumping rates were increased in approximate 50 gpm increments. Each step consisted of a short time segment during which groundwater was extracted at a constant rate while fluid levels were manually gauged within the groundwater production and LNAPL recovery wells, and monitored using pressure transducers installed within the three proximal piezometers. The groundwater extraction rate for each step was measured using an in-line flow meter. Results of the short-term step test are summarized in Section 4.2.

On January 10, 2015, focused pumping proceeded following the increase in the pumping rate to approximately 300 gpm. During focused pumping, system operational data (e.g., fluid level, flow rate, %LEL) were recorded. Operational data including pumping rates and groundwater elevations recorded during step testing and focused pumping are provided in Table 4. It should be noted that the %LEL in the headspace of the treated water being discharged into the Village of Hartford sewer main remained at 0.0% throughout the pilot test; therefore, the PID measurements were not included on Table 4 with the remainder of the operational data.

On February 12, 2015, the pumping rate was increased to approximately 320 gpm following issuance of Permit No. 2014-EE-58312-1 by the Illinois EPA Division of Water. Constant groundwater extraction rates were maintained with the exception of brief periods when the pumping rate was reduced or temporarily suspended due to: (1) high fluid levels in the Village of Hartford combined sewer overflow weir, or (2) during maintenance of the temporary treatment system. Maintenance activities generally consisted of replacing bag filters, periodic backwashing of the GAC media, as well as replacing spent GAC media within the treatment vessels. Between March 6 and 8, 2015, an amperage overload occurred several times in the transfer pump between the two GAC vessels, which temporarily suspended groundwater extraction due to high water level conditions within the frac tanks. As shown on Table 4, the average pumping rate was reduced during these three days while addressing the amperage issues within this transfer pump.

3.5 TREATMENT SYSTEM COMPLIANCE MONITORING

Effluent concentration limits for discharge of treated groundwater into the Village of Hartford CSS were established within the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a) for benzene, ethylbenzene, toluene, and xylenes; as well as agreements with the Village of Hartford (oil & grease) and City of Wood River (BOD and COD). Treated groundwater samples were collected at sample port SP-02 prior to discharge to the Village of Hartford CSS on a weekly basis following system startup. Weekly samples were also collected to assess influent groundwater quality prior to treatment (sample port SP-00) and to monitor for breakthrough of dissolved phase constituents within the primary GAC treatment vessel (sample port SP-01). Samples collected from sample ports SP-00 and SP-01 were not analyzed for BOD, COD, and oil and grease.

Results of the treatment system compliance monitoring and comparison to the effluent discharge limits are summarized in Tables 3A and 3B. Analytical results demonstrate that the discharge limits were not exceeded at any time during operation of the temporary treatment system. However, elevated benzene concentrations reported in the sample collected from port SP-01 on January 13, 2015 and samples collected from ports SP-01 and SP-02 on January 21, 2015, indicated that the GAC media was reaching adsorptive capacity for dissolved phase petroleum hydrocarbons. Therefore, between January 7 and 8, 2015, the GAC was extracted from the two 10,000-pound treatment vessels and replaced with regenerated carbon. The spent activated carbon was staged to the south of 309 North Olive Street and transported by Tetrasolv Services on February 8, 2015 for regeneration.

3.6 AMBIENT AIR MONITORING

Modelling of potential volatile emission rates prior to the pilot test determined that an air permit would not be required and that operations of the temporary treatment system was instead eligible for registration under the Illinois EPA Registration of Smaller Sources (ROSS) program. Monitoring of ambient air quality was continued during the resumed pilot test and appropriate documentation maintained to demonstrate compliance with the ROSS program, as well as to evaluate future air permitting requirements. Specifically, the effects of focused pumping and subsequent treatment of extracted groundwater on the ambient air quality immediately adjacent to the treatment system was assessed via collection of ambient air samples at one upwind and one downwind location. The upwind sample location was established to the southeast of 309 North Olive Street between the Premcor facility and the temporary treatment system. The downwind sample was collected to the north of 311 North Olive Street. Figure 1 shows the up and downwind sample locations. Ambient air samples were collected using passivated 6-liter Summa canisters and submitted to ALS Environmental for analysis of volatile petroleum related constituents using USEPA Method TO-15LL, which yields reporting limits approximately one-fifth of that provided via the standard TO-15 Method.

Ambient air samples were collected daily between January 9 and January 11 and submitted for expedited analysis to ALS Environmental. In subsequent weeks, 72-hour ambient air samples were collected on a weekly basis and submitted for standard analysis. A summary of the analytical results is provided in Table 5. Laboratory analytical reports for the ambient air samples collected during the pilot test are included in Appendix E.

As shown on Table 5, volatile petroleum and non-petroleum related constituents were routinely observed in both the upwind and downwind samples collected during the pilot test. However, results from the 24-hour samples collected during the first week of the pilot test indicated volatile petroleum related constituents in the downwind ambient air samples exceeded the upwind samples by a relative percent difference (RPD) greater than 25% for select constituents, particularly benzene. In accordance with the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a), leak detection monitoring was conducted on January 14, 2015 using a flame ionization detector to locate and mitigate the source(s) of the volatile emissions. Leak detection monitoring identified a malfunctioning pressure relief valve on the second frac tank and improperly sealed hatches on both frac tanks. The pressure relief valve was repaired and the hatches on the two frac tanks were resealed to reduce potential volatile hydrocarbon emissions. Subsequent air monitoring results indicated an overall reduction in the RPD between the upwind and downwind samples for petroleum related constituents. The RPD for benzene concentrations was less than 25% for the remainder of the resumed pilot test, with the exception of the final sample collected on March 5, 2015.

3.7 Focused Pumping Termination and System Decommissioning

In accordance with the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a), the pilot test was completed on March 10, 2015 following 60 days of continuous pumping. Focused pumping was not suspended during the resumed pilot test due to a triggering event such as elevated precipitation rates or high river stage. As shown on Figure 5, daily precipitation did not exceed more than 0.5 inch over a 24-hour period and the Mississippi River Stage did not exceed 410 ft-amsl as measured at the Melvin Price Lock and Dam in Alton, Illinois.

On March 10, 2015, decommissioning of the temporary groundwater treatment system began with draining the frac tanks and GAC vessels, followed by removing accumulated sediments. The frac tanks were demobilized on March 11, 2015. Following removal of the frac tanks, the riser pipe and submersible pump from the production well were removed, dismantled, decontaminated, and prepared for shipping. On March 12, 2015, a 50-ton crane was used to load the GAC vessels onto separate flatbed trailers for subsequent transport off-site. Prior to loading the vessels, the spent GAC was removed and transported for regeneration. Additional equipment such as transfer pumps, filter apparatus, hoses, and valves were also loaded onto flatbed trailers for shipment.

4.0 PILOT TEST RESULTS

The additional LNAPL recovery pilot test was designed to determine if a focused pumping approach could: (1) sustain unconfined conditions in the Main Sand stratum, (2) expose additional portions of the smear zone that are typically submerged beneath the water table, and (3) enhance recovery of potentially mobile LNAPL and volatile petroleum hydrocarbons present in the Main Sand stratum beneath Area A. Performance monitoring was conducted prior to initiating focused pumping to establish baseline conditions, as well as during and following completion of the pilot test to evaluate the effects of focused pumping on hydraulic conditions, LNAPL mobility, and mass recovery. Performance monitoring included manual and automated gauging of fluid levels, LNAPL baildown testing, vapor screening in the multiphase and vapor extraction wells located in Area A, as well as dissolved-phase monitoring. A summary of performance monitoring conducted prior to, during, and following focused pumping is provided in Table 6.

4.1 BASELINE FLUID LEVEL MONITORING

Manual fluid level gauging resumed on December 4, 2014 in twenty-seven wells situated in Area A, as well as two background locations outside of Area A (Table 6). Gauging was conducted weekly, primarily within the Main Sand stratum, to provide baseline fluid level data and to monitor drawdown across Area A following the commencement of focused pumping. Measurements recorded within the multipurpose monitoring points MP-035D and MP-085D provided ambient fluctuations in fluid level elevations in the Main Sand stratum attributed to precipitation, Mississippi River stage, and pumping at nearby facilities.

In addition to weekly manual gauging, pressure transducers were deployed in twelve groundwater monitoring locations within the Main Sand including ASW-01, ASW-03, HMW-044C, MP-035D, MP-054C, MP-133, MP-134, MP-135, MP-137, PZ-01, PZ-02, and PZ-03. Two additional pressure transducers deployed within multipurpose monitoring points MP-055C and MP-85D malfunctioned during focused pumping, and the data could not be retrieved from these transducers following the pilot test.

During baseline monitoring, the pressure transducers recorded the piezometric surface on an 8-hour interval. The measurement interval was modified prior to the beginning of focused pumping to 5-minutes to provide higher resolution data throughout the pilot test. Figure 7 presents hydrographs prepared using the pressure transducer results from select monitoring locations with increasing distance from the production well HPW-01. As shown on Figure 7, the piezometric surface at the beginning of focused pumping was higher than that observed at the beginning of the 2014 partial test. There was a slight increase in groundwater elevation in the Main Sand stratum in the week prior to the start of focused pumping; however, regional groundwater elevations, as measured at MP-035D, steadily declined throughout the 60-day test. Piezometric data recorded via the individual pressure transducers is included in Appendix F.

4.2 SHORT-TERM STEP TEST

The short-term pumping test was completed between January 9 and 10, 2015 to evaluate sustainable flow rates within the production well HPW-01. The groundwater recovery rate for each step during the test was estimated using the in-line flow meter. Groundwater levels were measured and recorded using the pressure transducer installed in the production well. The average pumping rates for the individual steps were 60.6, 97.4, 160.4, 196.1, 254.8, and 301.4 gpm. As shown on Figure 8, drawdown was initially steep as each step was initiated, after which drawdown stabilized within a short timeframe. The relationship between drawdown and discharge in a pumping well is described using the following equation (Jacobs 1947):

$$S_T = BQ + CQ^2$$

Where

S_T = total drawdown (feet)

B = aquifer loss coefficient (feet/gpm)

C = well loss coefficient (feet/gpm^2)

Q = discharge at each step (gpm)

The aquifer loss (B) and well loss (C) coefficients were calculated using Bierschenck's Method (Kasenow 2001), which applies a linear regression to the step-drawdown results. The aquifer loss coefficient (B) describes the drawdown in the pumping well attributed to laminar flow using the following equation from Bierschenk's Method:

$$B = \frac{\sum \frac{s}{Q} \sum Q^2 - \sum Q \sum s}{n \sum Q^2 - (\sum Q)^2}$$

The well loss coefficient (C) describes the drawdown in the pumping well attributed to turbulent flow through the formation using the equation:

$$C = \frac{n \sum s - \sum Q \sum \frac{s}{Q}}{n \sum Q^2 - (\sum Q)^2}$$

Where:

n = step number

s = drawdown at each step (feet)

As a partially penetrating well, both laminar and turbulent flow contribute to the discharge within production well HPW-01; however, laminar flow is the dominant mechanism by which groundwater flows to the pumping well. This is demonstrated using the following equations:

If:

$$s_a = BQ$$

And:

$$s_w = CQ^2$$

Then:

$$Q = \frac{s_a}{B} + \sqrt{\frac{s_w}{C}}$$

Where:

s_a = drawdown due to laminar flow (feet)

s_w = drawdown due to turbulent flow (feet)

Total drawdown at the production well is equivalent to the sum of the calculated drawdown attributed to laminar flow and the calculated drawdown attributed to turbulent flow. The aquifer loss coefficient (B) and the well loss coefficient (C) can be used to determine the well efficiency (E_w) for each step during the test using the following equation:

$$E_w = \frac{100BQ}{BQ + CQ^2}$$

A summary of the step-test analysis using Bierschenk's Method including the drawdown due to laminar flow, drawdown due to turbulent flow, and well efficiency is provided in Table 7. Well efficiency varies with increased discharge, and in the case of the production well, efficiency decreased with each step due to the decrease in the specific capacity of the well (*Q/s*) as time progressed and discharge increased. The aquifer loss coefficient (*B*) and the well loss coefficient (*C*) for the production well were calculated to be 0.014 feet/gpm and 8.4E-06 feet/gpm^2, respectively. As expected, the aquifer loss coefficient is substantially greater than the well loss coefficient due to the greater influence of laminar flow versus turbulent flow to the production well. Based on the results of the step test, the well efficiencies estimated for production well HPW-01 exceeded 80% for discharges up to 300 gpm, indicating sustainable recovery in the production well over time. Production wells that are properly designed, constructed, and developed do not generally exhibit well efficiencies greater than 80% (Patchick 1967, Driscoll 1986). These results indicate that production well HPW-01 was properly designed and effective at removing groundwater at rates up to 300 gpm and increasing the pumping rate up to 350 gpm is achievable in a sustainable manner.

4.3 LONG-TERM FOCUSED PUMPING TEST

Long-term focused pumping began at a rate of approximately 300 gpm on January 10, 2015 following the completion of the step test. On February 12, 2015, the pumping rate was increased to approximately 320 gpm following receipt of modified Permit No. 2014-EE-58312-1 issued by the Illinois EPA Division of Water. Constant pumping rates were generally maintained during the resumed pilot test as described in Section 3.3.

During focused pumping, manual fluid level measurements were collected in the production well (HPW-01) and LNAPL recovery well (HLRW-01) multiple times each day. Beginning on January 13, fluid level measurements were also collected at least once daily from the three groundwater piezometers (PZ-01 through PZ-03). In addition, fluid levels were gauged weekly within the 16 multipurpose monitoring points and groundwater monitoring wells situated in Area A, as well as the two background multipurpose monitoring points. The daily gauging measurements are summarized in Table 4. Weekly fluid level measurements are summarized in Table 8. It should be noted that fluid level measurements from the multiphase and SVE wells located in Area A are not included on Table 8, as the measurements collected during periods when vacuum is applied to these extraction wells are inaccurate. Additionally, fluid level measurements collected from the wells screened in the shallower hydrostratigraphic units unaffected by focused pumping (e.g., North Olive and Rand strata) were not included on Table 8.

A summary of the groundwater elevations measured in production well HPW-01 and other select monitoring locations in Area A with comparison to the background monitoring point MP-085D and the Mississippi River elevation are provided on Figure 9. A potentiometric surface map prepared using data collected on the final two days of focused pumping in included on Figure 10.

4.3.1 MISSISSIPPI RIVER ELEVATIONS

The Mississippi River elevation was measured below 399 ft-amsl in the days preceding the start of the pilot study and then increased by approximately 3-feet between January 10 and February 12, 2015. The river elevation subsequently decreased through March 8, 2015 reaching approximately the same elevation as observed at the start of focused pumping. The river elevation increased by nearly 6.5 feet between March 8 and March 20, 2015, at the end of the pilot test.

4.3.2 GROUNDWATER ELEVATIONS IN MAIN SAND STRATUM

Despite fluctuations in the Mississippi River, the groundwater elevations in the Main Sand stratum beneath Area A, as well as the background locations, decreased continuously over the 60-day pilot test. Groundwater elevations in the production well and other monitoring locations in Area A decreased significantly over the first three days of focused pumping and continued decreasing at a rate that was slightly greater than the background monitoring point MP-085D until approximately January 19, 2015 (Figure 9). Additional decreases in the groundwater elevations thereafter appear to be associated with regional trends in the Main Sand stratum (and not focused pumping) until February 12, 2015, when the rate of pumping was increased to 320 gpm. The rate of decreasing water levels beneath Area A was slightly greater than ambient decreases in the water table (measured in the background wells) over the subsequent two weeks (until approximately February 25, 2015); after which any additional lowering of the water table beneath Area A appears to be associated with regional trends. Groundwater elevations beneath Area A rebounded within one day of discontinuing focused pumping, after which any further increases appear to be attributable to the significant rise in the Mississippi River stage.

4.3.3 CORRECTED DRAWDOWN DURING FOCUSED PUMPING

The weekly fluid level measurements from the background monitoring locations (MP-035D and MP-085D) were used to estimate regional decreases in the water table. This regional change in the water table was then used to calculate corrected drawdown attributed to focused pumping in each of the monitoring locations in Area A. The corrected drawdown was estimated by first subtracting the average change in the ambient water table elevation within the two background locations from the drawdown estimated using the weekly measurements from the Area A monitoring network and then applying an additional correction factor that accounted for other influences on the water table in the Main Sand stratum beneath Area A. This second correction factor was applied since there were differences in the rate of water table fluctuation observed in Area A compared to the background locations following the termination of focused pumping. These differences in the rate of water table fluctuations suggest that there was either: (1) an additional influence depressing the water table beneath Area A (e.g., changes in operation of nearby wells at the Premcor facility) or (2) increasing groundwater elevations in the two background monitoring locations (e.g., changes in operations of production wells at the ConocoPhillips facilities) that needed to be accounted for in calculating drawdown attributed to pumping from production well HPW-01.

As shown on Table 8, a maximum corrected drawdown of approximately six feet was observed within groundwater production well HPW-01, with a corresponding drawdown of less than two feet in the piezometers and LNAPL recovery well installed in close proximity to the production well, and less than 0.5 feet of corrected drawdown approximately 250 feet from the production well during focused pumping. Figure 10 presents comparisons of the uncorrected and corrected drawdown calculated for the groundwater production well, LNAPL recovery well, select monitoring locations in Area A, as well as the background monitoring point MP-085D. The difference between the uncorrected and corrected drawdown at each location increases throughout focused pumping, as ambient decreases in the water table account for additional increases in the uncorrected drawdown within a short time after initiating pumping or increasing pumping rates (approximately 2 weeks), as described in previous subsection.

4.3.4 RADIUS OF INFLUENCE

The radius of influence (ROI) of focused pumping was determined by graphically comparing the corrected drawdown to the radial distance from the production well on a semi logarithmic plot, as shown on Figure 11. The ROI was estimated from manual gauging measurements collected on four separate dates during the pilot test including two dates when focused pumping was conducted at a rate of 300 gpm (January 13 and January 30) and two dates when focused pumping was performed at a rate of approximately 320 gpm (February 20 and March 10). These dates were selected to determine if the duration of pumping influenced the ROI. As shown on Figure 11, the ROI calculated for gauging results collected on January 13 (approximately 4 days after the start of pumping) was estimated at approximately 440 feet beneath Area A. By January 30, the ROI had increased to approximately 650 feet (after 21 days of pumping at 300 gpm). The ROI on February 20 and March 10, were approximately 695 and 710 feet respectively, at a pumping rate of 320 gpm. The ROI during the resumed pilot test was between 25% and 100% greater than that measured during the partial pilot test in early 2014 (Trihydro 2014b). The significant increase in ROI measured during the resumed pilot test can be attributed to: (1) higher sustained focused pumping rates and (2) decreasing ambient groundwater levels throughout the 60-day test.

4.3.5 TRANSMISSIVITY AND HYDRAULIC CONDUCTIVITY

The drawdown data collected daily from the LNAPL recovery well (HLRW-01) and piezometers (PZ-01 through PZ-03) were combined with the groundwater extraction rates recorded from the production well (HPW-01) to estimate the hydraulic properties within the Main Sand stratum beneath Area A. The Moench (1997) solution was selected to estimate hydraulic conductivity and transmissivity. The Moench solution is a multidimensional analysis that can reliably estimate hydraulic properties for data collected from partially penetrating wells within an unconfined aquifer. The analytical model considers early drainage of stored groundwater within the filter pack during pumping (referred to as borehole affects); in addition to the non-instantaneous release of water from portions of the aquifer that are located above a falling water table (referred to as delayed yield or delayed response). Delayed yield occurs due to elastic storage in the aquifer, in which little water actually drains from the pore space after initiating pumping. In an unconfined aquifer with delayed yield, the release of water from the pore space may take anywhere from minutes to days (Kasenow 2001). Over this period, groundwater remains in the pore spaces due to adhesion and cohesion processes, until such time that these hydrostatic forces can be overcome by gravity (Kasenow 2001). This delayed yield from above the water table can have a significant influence on the response of the aquifer during a pumping test, as observed during the partial pilot test performed in early 2014 (Trihydro 2014b).

The groundwater extraction rates, drawdown measurements, and well construction details were tabulated and uploaded into AQTESOLV™, an aquifer test analysis software package. The inputs and results from the modelling performed using the Moench solution within AQTESOLV™ is provided in Appendix G. The transmissivity of the Main Sand stratum beneath Area A was estimated at 8,142 feet^3/day with a hydraulic conductivity of 109 feet/day (3.8E-02 centimeters per second), assuming a saturated thickness of 75 feet within the Main Sand stratum. Previous hydraulic conductivity estimates for the central portions of the Hartford Site determined via slug testing performed under unconfined conditions in partially penetrating wells screened across the upper portions of the Main Sand range from 45 to 88 feet per day (1.6E-02 to 3.1E-02 centimeters per second, Clayton 2005). Additionally, hydraulic conductivity estimates reported via pump tests in the production wells installed in the Main Sand on the Premcor facility have been reported as high as 283 feet per day (1.0E-01 centimeters per second, Clayton 2005). The hydraulic conductivity and transmissivity calculated within the Main Sand beneath Area A are within the range of with historical measurements collected at the Hartford Site.

4.4 LNAPL OCCURRENCE IN AREA A

As summarized on Table 8, LNAPL was not observed in recovery well HLRW-01 nor the three piezometers located immediately adjacent to the groundwater production well in Area A during the 60-day pilot test. LNAPL thicknesses were not measured above 0.1-feet within any of the monitoring locations installed within 75 feet of the production well and screened in the Main Sand stratum. LNAPL was present at a greater thickness within several of the monitoring locations situated between 75 and 250 feet of the production well (including monitoring points MP-054C, MP-055C, MP-097D, MP-134, and MP-136), and while LNAPL thickness initially increased at the outset of pumping, it subsequently decreased within each of these wells over the duration of the pilot test. LNAPL was only present in a single location (monitoring point MP-055C at 0.02-feet) on the final day of the pilot test (March 10, 2015), when the water table was measured at the lowest elevation.

Figure 12 presents the potentiometric surface measured on March 9 and 10, 2015 relative to the LNAPL present in the smear zone as defined using laser induced fluorescence. With the exception of the production well, groundwater elevations in Area A were generally measured between 394.5 and 396 ft-amsl. The LNAPL smear zone is present between 385 and 400 ft-amsl beneath Area A. As shown on Figure 12, between 25 and 40% of the LNAPL smear zone was exposed at the end of the 60-day pilot test due to seasonally low groundwater elevations combined with the drawdown attributed to focused pumping. The extended ROI described in Section 4.3.4 combined with the high well efficiency described in Section 4.2 indicate that the production well was properly designed and constructed and did not contribute to the limited drawdown and exposure of the smear zone in Area A.

As shown on Table 2, while LNAPL saturations are heterogeneous in the soil cores collected beneath Area A (between 0.31 to 9.04%), the overall saturation is low and not indicative of mobile LNAPL within the sand and gravel alluvial deposits that make up the Main Sand stratum. Furthermore, there is not a significant difference in the average LNAPL saturations observed within the upper, middle, and lower portions of the smear zone. The saturation data suggests that even if the groundwater extraction rates were significantly increased and additional portions of the smear zone were exposed, there would likely not be an increase in the occurrence, thickness, mobility, or recovery of LNAPL in Area A.

4.4.1 LNAPL TRANSMISSIVITY

In December 2014, baseline LNAPL transmissivity testing was performed within well MPE-A002 (when vacuum was not applied to the extraction well) and monitoring point MP-055C, as these were the only two wells screened within the Main Sand stratum in Area A with sufficient LNAPL thickness (i.e., greater than 0.5 feet) to perform baildown testing. LNAPL baildown tests were performed in accordance with the *Standard Guide for Estimation of LNAPL Transmissivity* (ASTM 2011). Based on the groundwater elevation and depth of the C Clay in Area A, baildown testing was conducted under unconfined conditions.

Data collected during the baildown tests were evaluated using the *API LNAPL Transmissivity* numeric modeling spreadsheets (a summary of the results is provided in Appendix H). LNAPL transmissivity values (T_n) could not be calculated, as the baildown data did not conform to the analyses prescribed in Section 8.1.4 of the *Standard Guide for Estimation of LNAPL Transmissivity* (ASTM 2011). Specifically, relatively thin LNAPL thicknesses (b_n) and low drawdown (s_n) during recharge rendered plots of discharge (Q_n) versus drawdown (s_n) with significant scatter that could not be processed quantitatively.

Additional LNAPL baildown testing was proposed to be conducted during focused pumping once maximum, steady-state conditions were achieved as described within the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a). Prior to termination of focused pumping, the LNAPL thickness in each of the monitoring locations was measured below the requisite 0.5-feet minimum to conduct baildown testing. It should be noted that LNAPL thickness was greater than 0.5 feet in several of the MPE wells; however, vacuum was applied to these extraction wells and therefore baildown testing could not be performed.

4.5 VAPOR PHASE RECOVERY

Field screening of soil vapor, fixed gases, and airflow parameters (e.g., temperature, vacuum) within six vapor recovery wells located in Area A was conducted prior to, during, and following focused pumping to determine the influence of water table depression on mass recovery via vapor extraction. Field screening was completed within extraction wells MPE-A001 through MPE-A005 and HSVE-028S, in accordance with the procedures presented in Appendix D of the *Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan* (WSP 2011). Table 9 provides a summary of the field screening results. It should be noted that two additional SVE wells in Area A (HSVE-028D and HSVE-084) were not included in the routine screening. Operation of well HSVE-028D was discontinued by the Hartford Working Group after January 16, 2015 due to silt accumulations within the screen interval and well HSVE-084 did not have measurable airflow at any time during the pilot test.

The vacuum, differential pressure (within the Venturi tube), and temperature were measured within the six extraction wells to calculate the airflow extraction rate in standard cubic feet per minute (*scfm*). The volatile hydrocarbon mass removal rate (M) was then calculated using the following equation:

$$M = 1.557E\text{-}7 * C_{vapor} * MW * Q_{vapor}$$

Where:

M	=	rate of volatile petroleum hydrocarbons recovered (pounds per hour)
C_{vapor}	=	total organic vapor concentration relative to methane (parts per million by volume)
MW	=	molecular weight of recovered volatile petroleum hydrocarbons (95 grams/mol)
Q_{vapor}	=	soil vapor flow rate (standard cubic feet per minute)
1.557E-7	=	conversion constant derived as (1 mol/24.06 liters) x (1 pound/453.6 grams) x (1 cubic meter/35.3 cubic feet) x (60 minutes/hour) x (1 liter/1,000 milliliters)

The mass removal rate was converted to equivalent gallons per day assuming a LNAPL density of 6.2 pounds per gallon. Individual and combined mass removal rates for the MPE wells, along with the corrected groundwater elevation for monitoring well MP-135 are presented on Figure 13. From January 8, 2015 (prior to the start of focused pumping) until January 20, 2015, the combined recovery rate measured within the MPE wells was negligible, largely due to lack of exposed well screens. As the pilot test progressed, recovery rates increased up to a maximum combined rate of 342 gallons per day occurring on February 27, 2015. Cumulative recovery remained above 300 gallons per day until March 11, 2015. Following termination of pumping, the mass removal rate decreased to between 140 and 230 gallons per day as the water table rebounded beneath Area A. The increase and decrease in recovery rates appears inversely correlated with groundwater elevations within the Main Sand stratum, with a marked increase when the groundwater elevation in monitoring point MP-135 was below 396 ft-amsl.

Approximately 10,850 gallons of volatile petroleum hydrocarbons were recovered from the five MPE wells via vapor extraction between January 20 and March 11, 2015. Volatile petroleum hydrocarbons extracted in Area A accounted for between 3.4 and 17.2% of the total mass recovered via the SVE system, with an average of 9.2% of the daily mass recovery attributed to the MPE wells (after January 20). For comparison, there were between 81 and 87 additional SVE wells operating across the Hartford Site over this timeframe between early January and early April 2015.

4.6 DISSOLVED PHASE MONITORING

Due to the proximity of the operating production wells, the ROI associated with hydraulic control being performed on the former Premcor refinery and focused pumping from groundwater production well HPW-01 installed in Area A may overlap creating a potential for redistribution of dissolved phase petroleum hydrocarbons during the additional LNAPL recovery pilot test. To assess any change in dissolved phase concentrations associated with focused pumping, groundwater samples were collected from the monitoring locations identified in Table 6 prior to the start of and during focused pumping and will continue to be collected monthly for a six-month period following completion of resumed focused pumping, with the final sample scheduled to be collected in August 2015.

Groundwater samples were collected using a low flow sampling methodology as described in the *Dissolved Phase Investigation Work Plan* (Trihydro 2013b). In accordance with this work plan, samples were only collected when groundwater elevation was gauged within the screened interval of the monitoring well. Groundwater samples were not collected if LNAPL was measured within a monitoring location or a sheen was observed on the groundwater during purging activities. Groundwater samples were analyzed for select petroleum-related constituents including benzene, toluene, ethylbenzene, total xylenes, and methyl tert-butyl ether via USEPA Method 8260B by Teklab, Inc. Field forms generated during groundwater monitoring are provided in Appendix I-1, and laboratory analytical reports are included in Appendix I-2. Table 10 provides a summary of the dissolved phase analytical results for monitoring performed before the start of resumed focused pumping and then monthly thereafter through May 2015.

As summarized on Table 10, while dissolved phase concentrations fluctuated, there were not significant differences prior to, during, or following focused pumping in any of the monitoring locations. In general, benzene concentrations exceeded 20 milligrams per liter in all of the samples, with the exception of groundwater samples collected from monitoring point HMW-044D (which is screened below the smear zone in the Main Sand stratum). These elevated dissolved phase benzene concentrations appear to be at the effective solubility limit for the LNAPL source as described within the *Revised LNAPL Component to the Conceptual Site Model* (Trihydro 2014a). Since dissolved phase concentrations appear to be at equilibrium with the LNAPL source beneath Area A, there was not any redistribution of dissolved hydrocarbons within the ROI of the production well during the additional LNAPL recovery pilot test.

5.0 CONCLUSIONS

The resumed additional LNAPL recovery pilot test began on January 9, 2015 with step testing and was concluded on March 10, 2015, in accordance with the *Final Light Non-Aqueous Phase Liquid Recovery Pilot Test Work Plan Addendum* (Trihydro 2013a) and modifications described in the *Final Additional Light Non-Aqueous Phase Liquid Recovery Partial Pilot Test Summary Report* (Trihydro 2014b). Focused pumping was performed in Area A over the proposed 60-day period when groundwater elevations in the Main Sand stratum were below the trigger levels. A discussion of the effectiveness of focused pumping in the context of the pilot test objectives, as well as a conceptual path forward is described within this section.

5.1 EFFECTIVE DRAWDOWN AND EXPOSURE OF LNAPL SMEAR ZONE

The first two objectives of the additional LNAPL recovery pilot test were to determine if focused pumping could sustain unconfined conditions and expose additional portions of the smear zone beneath Area A when groundwater in the Main Sand stratum was unconfined. The well efficiency at production well HPW-01 exceeded 80% for discharges up to 300 gpm, which is indicative of a properly designed, constructed, and developed production well. The estimated ROI ranged from 650 to 710 feet beneath Area A after three weeks of pumping at rates between 300 and 320 gpm, which exceeded the modelled ROI of 300 feet. However, corrected drawdown (Table 8) was limited to less than six feet in the production well, less than two feet within a ten-foot radius, and generally less than a foot in the remaining wells within the influence of the production well. Groundwater transmissivities in the Main Sand stratum were such that even during seasonally low groundwater conditions (i.e., groundwater below 400 ft-amsl), pumping at rates of 300 to 320 gpm were not effective at exposing the lower reaches of the smear zone beneath Area A.

5.2 LNAPL AND VOLATILE HYDROCARBON RECOVERY

As discussed in the DOLR conceptual model (Trihydro 2014a) and demonstrated during pilot testing performed in Area A (WSP 2012), the potential for LNAPL recoverability under confined conditions is minimal. During pilot testing in 2011 and 2012, there was a limited degree of drawdown that was induced within a small radius about the MPE wells under confining conditions, which limited mobilization and recovery of LNAPL or volatile petroleum hydrocarbons. Therefore, the third objective of the pilot test was to evaluate recoverability of mobile LNAPL and volatile petroleum hydrocarbons during unconfined conditions in the Main Sand stratum when additional portions of the smear zone were exposed.

As shown on Figure 12, between 25 and 40% of the LNAPL smear zone was exposed at the end of the 60-day pilot test due to seasonally low groundwater elevations combined with the drawdown attributed to focused pumping. However, LNAPL was not observed in recovery well HLRW-01 nor the three piezometers located immediately adjacent to the groundwater production well during the 60-day pilot test. LNAPL thicknesses were not measured above 0.1 feet within any of the monitoring locations installed within 75 feet of the production well; and while LNAPL was initially present at a greater thickness within several of the monitoring locations situated between 75 and 250 feet of the production well, it subsequently decreased over the duration of the pilot test. LNAPL was only present in a single location (monitoring point MP-055C at 0.02-feet) on the final day of the pilot test when the water table was measured at the lowest elevation.

As shown on Table 2, while LNAPL saturations are heterogeneous in the soil cores collected beneath Area A (between 0.31 to 9.04%), the overall saturation is low and not indicative of mobile LNAPL within the sand and gravel alluvial deposits that make up the Main Sand stratum. Furthermore, there is not a significant difference in the average LNAPL saturations observed within the upper, middle, and lower portions of the smear zone. The saturation data suggest that even if the groundwater extraction rates were significantly increased and additional portions of the smear zone were exposed, there would likely not be an increase in the occurrence, thickness, mobility, or recovery of LNAPL in Area A.

While LNAPL recovery was not enhanced via focused pumping, mass loss rates due to volatilization and subsequent vapor extraction significantly increased over the course of the pilot test. Prior to the start and during the first 10 days of focused pumping, the recovery rates measured within the MPE wells were negligible, largely due to lack of exposed well screens even though ambient groundwater conditions were unconfined. As the pilot test progressed, recovery rates increased to more than 300 gallons per day between February 27, 2015 and March 11, 2015. Following termination of pumping, the mass removal rates decreased by between 30 and 50% as the water table rebounded beneath Area A. The increase and subsequent decrease in cumulative mass recovery rates appears to be inversely correlated with groundwater elevations within the Main Sand stratum (Figure 9). In the absence of focused pumping, mass removal rates would have likely been negligible from the MPE wells, as the screen interval would have remained occluded when a vacuum was applied to these wells.

Approximately 10,850 gallons of volatile petroleum hydrocarbons were recovered from the five MPE wells via vapor extraction between January 20 and March 11, 2015 (an average mass removal rate of 210 gallons per day). Volatile petroleum hydrocarbons extracted in Area A accounted for between 3.4 and 17.2% of the total mass recovered via the SVE system, with an average of 9.2% of the daily mass recovery attributed to the MPE wells. The MPE wells accounted for approximately 5% of the extraction wells operating at the Hartford Site over this timeframe.

5.3 PATH FORWARD

The additional LNAPL recovery pilot test results described herein will be used to resolve gaps in the Comprehensive Conceptual Site Model (CSM) for the Hartford Site. Specifically, the results of this pilot test, combined with previous testing, will provide an understanding of LNAPL recoverability under the range of expected hydraulic conditions within the Main Sand stratum (where the majority of the petroleum hydrocarbon mass is present) and will inform a multiphase remedy approach including consideration of potential endpoints for future corrective measures. In an effort to consider the results of the additional LNAPL recovery pilot testing performed in Area A to the remainder of the Hartford Site, further evaluation of the historical and more recent monitoring results was performed.

Area A was identified within the *Active LNAPL Recovery System 90% Design Report* (Clayton Group Services, Inc., et al., 2006) as a portion of the Hartford Site where LNAPL recovery would be optimal. The boundaries of Area A were determined based on a compilation and review of multiple data sets including:

- Cone penetrometer testing and lithologic descriptions
- Laser induced fluorescence and observations pertaining to presence of petroleum hydrocarbons (e.g., odor, sheening, total organic vapor measurements, etc.) during installation of soil borings
- Structural contours, stratigraphic isopachs, and lateral stratigraphic boundaries of the hydrostratigraphic and confining units
- Groundwater elevations over a range of hydraulic conditions in the various hydrostratigraphic units
- Apparent LNAPL thickness within the various stratum
- LNAPL specific thicknesses within a selection of groundwater monitoring locations
- LNAPL conductivity and transmissivity within a selection of groundwater monitoring locations
- Historical LNAPL and volatile petroleum hydrocarbon recovery, as well as LNAPL recharge rates during pilot testing and SVE operations

Additional geostatistical analysis of more recent monitoring results was performed to assess the degree to which petroleum hydrocarbons are present within the various media beneath the Hartford Site. This analysis was conducted to determine if Area A remained an optimal location for pilot testing of remedial alternatives. For simplification, several data sets were analyzed and the results were separated into quintiles (i.e., each quintile represents the 20^{th} percentile of the respective data) and designated with a simple 1-5 ranking from low to high. After which, polygons were created bounding each of the sample/measurement locations in an effort to subdivide the Hartford Site into representative areas based on available data. Geostatistical analyses were performed using the following data sets:

- Total volatile petroleum hydrocarbon concentrations measured in shallow soil vapor during seasonal low water table conditions in January 2015 are presented on Figure 15.
- Total volatile petroleum hydrocarbon concentrations measured in the SVE wells during low water table conditions in October 2012 are shown on Figure 16. Vapor screening results from October 2012 were selected as this correlates to the period with the greatest mass recovery rate via vapor extraction at the Hartford Site since the system was installed.
- Dissolved benzene concentrations measured in wells screened in the Main Sand stratum between 2011 and 2014 are depicted on Figure 17. An extended timeframe for dissolved phase benzene was utilized, as there is a lower density of groundwater monitoring data available.
- LNAPL thicknesses measured in the Main Sand stratum in March 2015, during focused pumping and ambient seasonal low water table conditions, are shown on Figure 18.
- A virtual overlay showing a composite of each of these individual geostatistical analyses is provided on Figure 19. Figure 19 also includes the potential remediation areas defined within the *Active LNAPL Recovery System 90% Design Report* (Clayton Group Services, Inc. 2006) for comparison.

These geostatistical analyses reinforce the significant heterogeneity in the distribution of petroleum hydrocarbons beneath the Hartford Site. For instance, Figure 15 shows a highly discontinuous distribution of volatile hydrocarbons in the shallow hydrostratigraphic units (primarily the Rand and North Olive strata) in January 2015. Vapor monitoring locations with elevated total petroleum concentrations measured in early 2015 do not correlate with areas with the highest concentrations of total petroleum concentrations measured within extracted vapors collected from the SVE wells in October 2012 (Figure 16). Additionally, monitoring locations with the highest dissolved phase benzene concentrations (located in the southern portions of the Hartford Site as shown on Figure 17) do not correlate with areas with the most significant LNAPL thicknesses during the resumed pilot test (primarily within the central and northern portions of the Hartford Site as shown on Figure 18).

Some of the variability in the data sets may be attributable to spatial and temporal variability in the routine monitoring that has been performed. Irrespective, the virtual overlay presented on Figure 19 provides a preliminary indication of portions of the Hartford Site that may be most heavily impacted with petroleum hydrocarbons and should be considered during future development of a multiphase remedy. Overall, the results of this geostatistical analysis show good agreement with the potential remediation areas (but not the remedial technologies) defined within the *Active LNAPL Recovery System 90% Design Report* (Clayton Group Services, Inc. 2006). Specifically, Area A is one of just a few locations with the highest ranking identified on the composite overlay. This analysis may be expanded as part of the multiphase remedy framework to rank areas for optimization of interim remedial efforts (primarily vapor extraction), as well as future pilot testing of additional alternatives (e.g., bioaugmentation, biostimulation, natural source zone depletion, etc.)

6.0 REFERENCES

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TABLES

TABLE 1A. SOIL ANALYTICAL RESULTS SUMMARY, VOLATILE PETROLEUM CONSTITUENTS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Sampled	Benzene (mg/kg)	n-Butyl-benzene (mg/kg)	sec-Butylbenzene (mg/kg)	Ethyl-benzene (mg/kg)	Heptane (mg/kg)	Hexane (mg/kg)	Isopropyl-benzene (mg/kg)	p-Isopropyl-toluene (mg/kg)	Methylene Chloride (mg/kg)	n-Propyl-benzene (mg/kg)	Toluene (mg/kg)	1,2,3-Trimethyl-benzene (mg/kg)	1,2,4-Trimethyl-benzene (mg/kg)	1,3,5-Trimethyl-benzene (mg/kg)	m,p-Xylene (mg/kg)	o-Xylene (mg/kg)	Xylenes, Total (mg/kg)
PZ-01 (28-29)	10/28/14	4.0	8.6	4.1	9.6	72	19	2.9	2.6	1.6	14	20	48	240	74	330	130	460
PZ-01 (31-32)	10/28/14	ND(0.62)	16	6.2	1.0	ND(12)	ND(12)	ND(3.1)	3.4	ND(3.1)	7.2	0.66	70	260	79	4.5	2.5	7.0
PZ-01 (35-36)	10/28/14	3.0	1.4	0.49	3.6	3.0	4.1	0.36	0.25	ND(0.45)	1.8	11	4.5	15	5.5	14	5.5	20
PZ-01 (40-41)	10/28/14	8.8	4.5	1.1	11	12	18	1.2	0.58	ND(2.5)	4.9	7.7	8.8	38	11	38	13	52
PZ-02 (28-29)	10/27/14	ND(1.2)	11	4.2	7.7	25	6.5	3.1	2.8	2.1	14	7.0	56	160	86	250	120	370
PZ-02 (31-32)	10/27/14	0.70	22	9.4	ND(2.4)	ND(9.6)	ND(9.6)	0.51	4.5	0.60	7.1	ND(2.4)	92	310	81	1.4	1.9	3.3
PZ-02 (35-36)	10/27/14	33	7.3	3.3	49	39	45	5.9	ND(11)	ND(11)	19	120	26	120	36	190	74	260
PZ-02 (40-41)	10/27/14	110	13	6.0	120	130	220	6.7	2.8	ND(4.6)	40	100	41	160	62	340	120	460
PZ-03 (28-29)	10/29/14	3.8	2.7	ND(9.3)	18	27	22	2.0	ND(9.3)	ND(9.3)	7.7	34	13	56	18	94	36	130
PZ-03 (31-32)	10/29/14	6.1	20	10	86	40	40	14	4.6	ND(10)	70	150	80	370	130	380	160	540
PZ-03 (35-36)	10/29/14	52	7.0	2.8	65	62	100	4.6	1.2	ND(2.4)	22	140	22	84	33	150	55	200
PZ-03 (40-41)	10/29/14	29	6.5	1.6	31	33	51	2.8	ND(5.3)	ND(5.3)	12	1.1	13	60	16	84	1.5	86
Average (28-29)		3.0	7.8	5.9	12	41	16	2.7	4.8	4.3	12	20	39	160	59	220	95	320
Average (31-32)		2.5	19	9.2	30	21	21	5.9	4.2	4.6	28	51	81	310	97	130	55	180
Average (35-36)		29	5.2	2.2	39	35	50	3.6	4.1	4.6	14	90	18	73	25	120	45	160
Average (40-41)		49	8.0	3.0	54	58	96	4.2	2.9	4.1	19	36	21	93	30	150	45	200

Notes:

- Only detected analytes included in summary table

mg/kg - milligrams per kilogram

ND(1.2) - not detected at the indicated reporting limit

TABLE 1B. SOIL ANALYTICAL RESULTS SUMMARY, SEMIVOLATILE PETROLEUM RELEATED CONSTITUENTS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Sampled	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Dibenzofuran (mg/kg)	2,4- Dimethyl-phenol (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	2-Methyl-naphthalene (mg/kg)	2-Methylphenol (mg/kg)	3,4-Methyl phenol (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Phenol (mg/kg)	Pyrene (mg/kg)
PZ-01 (28-29)	10/28/14	ND(0.040)	ND(0.040)	ND(0.040)	ND(0.48)	0.43	ND(0.040)	ND(0.040)	0.34	0.28	0.28	0.33	ND(0.040)	0.22	ND(0.040)
PZ-01 (31-32)	10/28/14	1.2	0.29	0.18	0.67	ND(3.1)	ND(0.21)	1.1	58	ND(3.1)	ND(3.1)	49	3.1	ND(2.2)	0.29
PZ-01 (35-36)	10/28/14	0.10	ND(0.030)	ND(0.030)	ND(0.40)	ND(0.57)	ND(0.030)	0.11	2.9	ND(0.57)	ND(0.57)	1.6	0.31	ND(0.4)	0.031
PZ-01 (40-41)	10/28/14	ND(0.19)	ND(0.19)	ND(0.19)	ND(2.0)	ND(2.8)	ND(0.19)	ND(0.19)	3.2	ND(2.8)	ND(2.8)	1.9	0.36	ND(2.0)	ND(0.19)
PZ-02 (28-29)	10/27/14	ND(0.040)	ND(0.040)	ND(0.040)	ND(0.46)	0.25	ND(0.040)	ND(0.040)	0.29	ND(0.66)	ND(0.66)	0.20	ND(0.040)	ND(0.46)	ND(0.040)
PZ-02 (31-32)	10/27/14	0.47	ND(0.040)	0.068	0.34	ND(6.1)	0.040	0.48	23	ND(0.61)	ND(0.61)	19	1.2	ND(0.42)	0.12
PZ-02 (35-36)	10/27/14	0.20	0.049	0.033	ND(0.43)	ND(0.61)	ND(0.040)	0.20	5.4	ND(0.61)	ND(0.61)	3.5	0.56	ND(0.43)	0.054
PZ-02 (40-41)	10/27/14	1.5	0.37	ND(0.37)	ND(3.9)	ND(5.5)	ND(0.37)	1.4	39	ND(5.5)	ND(5.5)	27	3.8	ND(3.9)	0.26
PZ-03 (28-29)	10/28/14	0.49	ND(0.20)	ND(0.20)	ND(2.1)	ND(3.0)	ND(0.20)	0.45	18	ND(3.0)	ND(3.0)	14	1.2	ND(2.1)	ND(0.20)
PZ-03 (31-32)	10/28/14	0.74	0.17	ND(0.21)	ND(2.2)	ND(3.1)	ND(0.21)	0.69	27	ND(3.1)	ND(3.1)	23	1.9	ND(2.2)	0.18
PZ-03 (35-36)	10/28/14	0.16	0.038	ND(0.040)	ND(0.41)	ND(0.59)	ND(0.040)	0.16	4.6	ND(0.59)	ND(0.59)	3.3	0.44	ND(0.41)	0.043
PZ-03 (40-41)	10/28/14	ND(0.38)	ND(0.38)	ND(0.38)	ND(4.0)	ND(5.7)	ND(0.38)	ND(0.38)	3.0	ND(5.7)	ND(5.7)	1.6	0.37	ND(4.0)	ND(0.38)
Average (28-29)		0.19	0.093	0.093	1.0	1.2	0.093	0.18	6.2	1.3	1.3	4.8	0.43	0.93	0.093
Average (31-32)		0.80	0.17	0.15	1.1	4.1	0.15	0.76	36	2.3	2.3	30	2.1	1.6	0.20
Average (35-36)		0.15	0.039	0.034	0.41	0.59	0.037	0.16	4.3	0.59	0.59	2.6	0.44	0.41	0.043
Average (40-41)		0.69	0.31	0.31	3.3	4.7	0.31	0.66	15	4.7	4.7	10	1.5	3.3	0.28

Notes:

- Only detected analytes included in summary table

mg/kg - milligrams per kilogram

ND(0.38) - not detected at the indicated reporting limit

TABLE 1C. SOIL ANALYTICAL RESULTS SUMMARY, TOTAL PETROLEUM HYDROCARBONS HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Sampled	Diese Range Organics (mg/kg)	Gasoline Range Organics (mg/kg)
PZ-01 (28-29)	10/28/14	37	4,600
PZ-01 (31-32)	10/28/14	4,300	600
PZ-01 (35-36)	10/28/14	260	240
PZ-01 (40-41)	10/28/14	310	830
PZ-02 (28-29)	10/27/14	36	3,800
PZ-02 (31-32)	10/27/14	1,800	510
PZ-02 (35-36)	10/27/14	710	3,800
PZ-02 (40-41)	10/27/14	5,400	6,700
PZ-03 (28-29)	10/29/14	1,700	2,100
PZ-03 (31-32)	10/29/14	2,800	6,400
PZ-03 (35-36)	10/29/14	550	3,700
PZ-03 (40-41)	10/29/14	270	1,900
Average (28-29)		590	3,500
Average (31-32)		3,000	2,500
Average (35-36)		510	2,600
Average (40-41)		2,000	3,100

Notes:

mg/kg - milligrams per kilogram

TABLE 1D. SOIL PHYSICAL PROPERTIES RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Sampled	Bulk Density (g/cm^3)	Moisture Content (%)	Estimated Porosity (cm^3/cm^3)
PZ-01 (28-29)	10/28/14	1.9	39	0.43
PZ-01 (31-32)	10/28/14	1.9	25	0.32
PZ-01 (35-36)	10/28/14	2.1	15	0.24
PZ-01 (40-41)	10/28/14	2.0	14	0.21
PZ-02 (28-29)	10/27/14	1.9	35	0.40
PZ-02 (31-32)	10/27/14	1.9	23	0.31
PZ-02 (35-36)	10/27/14	2.0	24	0.32
PZ-02 (40-41)	10/27/14	2.1	11	0.18
PZ-03 (28-29)	10/29/14	2.0	22	0.31
PZ-03 (31-32)	10/29/14	1.9	28	0.35
PZ-03 (35-36)	10/29/14	1.9	19	0.27
PZ-03 (40-41)	10/29/14	2.0	14	0.22

Notes:

% - percent by mass

cm^3 - cubic centimeter

g - grams

TABLE 2. LNAPL SATURATION ESTIMATES
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Soil Samples	Sample Interval	TPH Concentration (mg/kg)	Bulk Density[1] (g/cm^3)	Porosity[2] (cm^3/cm^3)	LNAPL Saturation[3] (%)
PZ-01 (28-29)	Smear Zone Top	4,637	1.90	0.41	2.79
PZ-01 (31-32)	Smear Zone Middle 1	4,900	1.90	0.45	2.73
PZ-01 (35-36)	Smear Zone Middle 2	500	2.10	0.45	0.31
PZ-01 (40-41)	Smear Zone Bottom	1,140	2.00	0.37	0.81
PZ-01	Smear Zone Average	2,794	1.98	0.42	1.72
PZ-02 (28-29)	Smear Zone Top	3,836	1.90	0.41	2.30
PZ-02 (31-32)	Smear Zone Middle 1	2,310	1.90	0.45	1.29
PZ-02 (35-36)	Smear Zone Middle 2	4,510	2.00	0.45	2.62
PZ-02 (40-41)	Smear Zone Bottom	12,100	2.10	0.37	9.04
PZ-02	Smear Zone Average	5,689	1.98	0.42	3.50
PZ-03 (28-29)	Smear Zone Top	3,800	2.00	0.41	2.40
PZ-03 (31-32)	Smear Zone Middle 1	9,200	1.90	0.45	5.12
PZ-03 (35-36)	Smear Zone Middle 2	4,250	1.90	0.45	2.35
PZ-03 (40-41)	Smear Zone Bottom	2,170	2.00	0.37	1.54
PZ-03	Smear Zone Average	4,855	1.95	0.42	2.95
Average (28-29)	Smear Zone Top	4,090	1.93	0.41	2.50
Average (31-32)	Smear Zone Middle 1	5,500	1.90	0.45	3.06
Average (35-36)	Smear Zone Middle 2	3,080	2.00	0.45	1.79
Average (40-41)	Smear Zone Bottom	5,100	2.03	0.37	3.69
Area A	Smear Zone Average	4,443	1.97	0.42	2.72

Notes:

1 - Bulk density based on the depth specific geophysical data

2 - Porosity based on the depth specific geophysical data from sample location HCSB-01

3 - LNAPL density of 0.7641 g/cm^3 assumed based on sample collected from well HMW-044C

cm^3 - cubic centimeter

g - gram

kg - kilogram

mg - milligram

TABLE 3A. GROUNDWATER TREATMENT COMPLIANCE MONITORING ANALYTICAL RESULTS
VOLATILE PETROLEUM RELATED CONSTITUENTS, METALS, AND GENERAL WATER QUALITY PARAMETERS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylene, Total (mg/L)	MTBE (mg/L)	Oil and Grease (mg/L)	Chemical Oxygen Demand (mg/L)	Biochemical Oxygen Demand (mg/L)	Arsenic, Dissolved (mg/L)	Lead, Dissolved (mg/L)	Hardness, as $CaCO_3$ (mg/L)
SP-00	12/31/14	0.022	0.0026 J	ND(0.0050)	0.0041 J	0.0018 J	--	--	--	--	--	--
	1/13/15	0.88	0.014 J	0.027 J	0.031 J	ND(0.020)	--	--	--	--	--	--
	1/21/15	1.0	0.017 J	0.022 J	0.036 J	ND(0.020)	--	--	--	--	--	--
	1/30/15	0.96	0.020 J	0.026 J	0.040 J	ND(0.020)	--	--	--	--	--	--
	2/5/15	1.0	0.022 J	0.029 J	0.054	ND(0.020)	--	--	--	--	--	--
	2/12/15	1.1	0.024 J	0.030 J	0.059	ND(0.020)	--	--	--	--	--	--
	2/20/15	1.3	0.020 J	0.026 J	0.049 J	ND(0.020)	--	--	--	--	--	--
	2/25/15	1.4	0.020 J	0.029 J	0.050	ND(0.020)	--	--	--	--	--	--
	3/9/15	1.3	0.022 J	0.032 J	0.056	ND(0.020)	--	--	--	--	--	--
SP-01	12/31/14	ND(0.0020)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0020)	--	--	--	--	--	--
	1/13/15	0.43	ND(0.050)	0.012 J	0.019 J	ND(0.020)	--	--	--	--	--	--
	1/21/15	0.71	ND(0.050)	0.014 J	0.023 J	ND(0.020)	--	--	--	--	--	--
	1/30/15	0.66	ND(0.050)	0.017 J	0.027 J	ND(0.020)	--	--	--	--	--	--
	2/5/15	0.76	ND(0.050)	0.020 J	0.031 J	ND(0.020)	--	--	--	--	--	--
	2/12/15	0.0021	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0020)	--	--	--	--	--	--
	2/20/15	0.0044	ND(0.0050)	ND(0.0050)	ND(0.0050)	0.00060 J	--	--	--	--	--	--
	2/25/15	0.038	ND(0.0050)	ND(0.0050)	ND(0.0050)	0.00090 J	--	--	--	--	--	--
	3/9/15	0.17	ND(0.0050)	ND(0.050)	ND(0.050)	ND(0.020)	--	--	--	--	--	--
SP-02	12/31/14	ND(0.0020)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0020)	2.0	28	ND(5.0)	0.022	ND(0.0069)	360
	1/13/15	0.064	ND(0.0050)	0.0013 J	0.0021 J	ND(0.020)	ND(6.0)	ND(50)	ND(5.0)	0.00050 J	0.0090 J	470
	1/21/15	0.40	ND(0.050)	ND(0.050)	0.014 J	ND(0.020)	ND(6.0)	ND(50)	ND(5.0)	0.00070 J	ND(0.0010)	460
	1/30/15	0.54	ND(0.050)	0.014 J	0.024 J	ND(0.020)	ND(6.0)	ND(50)	ND(5.0)	0.0010 J	0.00030 J	460
	2/5/15	0.57	ND(0.050)	0.014 J	0.022 J	ND(0.020)	2.0 J	ND(50)	ND(5.0)	0.0032	ND(0.0010)	470
	2/12/15	0.00080	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0020)	2.0 J	ND(50)	ND(5.0)	0.00090 J	0.00070 J	460
	2/20/15	ND(0.0020)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0020)	ND(6.0)	ND(50)	ND(5.0)	0.00080 J	ND(0.0010)	460
	2/25/15	ND(0.0020)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0020)	2.0 J	ND(50)	ND(5.0)	0.00070 J	ND(0.0010)	450
	3/9/15	0.00060 J	ND(0.0050)	ND(0.0050)	ND(0.0050)	0.00020 J	2.0 J	26 J	ND(5.0)	0.00070 J	ND(0.0010)	440
Limit for Discharge to Village of Hartford CSS		4.2 (AS)[1] 0.86 (CS)[1]	0.15 (AS)[1] 0.014 (CS)[1]	2.0 (AS)[1] 0.60 (CS)[1]	0.92 (AS)[1] 0.36 (CS)[1]	NA	100[2]	NA	204[3]	0.36 (AS)[1] 0.19 (CS)[1]	300-369 (AS)[1] 62.8-81.6 (CS)[1]	NA

Notes:

[1] - Acute standard (AS) and the chronic standard (CS) as defined by Title 35 of the Illinois Administrative Code, Subtitle C, Chapter I, Part 302

[2] - Village of Hartford Code - Utilities 38-4-1 Article IV-Wastewater System, Appendix 7

[3] - City of Wood River Ordinance 88-9, Section 51.076.F.1

- SP-00 - Collected following filtration but prior to the first granular activated carbon treatment vessel
- SP-01 - Collected from the effluent of the first granular activated carbon treatment vessel
- SP-02 - Collected from the effluent of the second granular activated carbon treatment system prior to discharge to the Village of Hartford CSS

-- constituent not included in analysis

CSS - combined sewer system

J - estimated concentration

mg/L - milligrams per liter

ND(0.0001) - not detected at the indicated reporting limit

NA - not applicable

TABLE 3B. GROUNDWATER TREATMENT COMPLIANCE MONITORING ANALYTICAL RESULTS
SEMIVOLATILE PETROLEUM RELATED CONSTITUENTS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Acenaphthene (mg/L)	Acenaphthylene (mg/L)	Anthracene (mg/L)	Benzo(a)-anthracene (mg/L)	Benzo(a)-pyrene (mg/L)	Benzo(b)-fluoranthene (mg/L)	Benzo(g,h,i)-perylene (mg/L)	Benzo(k)-fluoranthene (mg/L)	Chrysene (mg/L)	Dibenzo(a,h)-anthracene (mg/L)	Fluoranthene (mg/L)	Fluorene (mg/L)	Indeno (1,2,3-cd) pyrene (mg/L)	Naphthalene (mg/L)	Phenanthrene (mg/L)	Pyrene (mg/L)
SP-00	12/31/14	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00040	0.00030 J	ND(0.00010)
	1/13/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0020	0.00017	ND(0.00010)
	1/21/15	0.00011	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00010	ND(0.00010)	0.0023	0.00012	ND(0.00010)
	1/30/15	0.00010	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00012	ND(0.00010)	0.0022	0.00023	ND(0.00010)
	2/5/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0020	0.00013	ND(0.00010)
	2/12/15	0.00010	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00011	ND(0.00010)	0.0025	0.00018	ND(0.00010)
	2/20/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00010	ND(0.00010)	0.0025	0.00015	ND(0.00010)
	2/25/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00011	ND(0.00010)	0.0025	0.00020	ND(0.00010)
	3/9/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00012	ND(0.00010)	0.0058	0.00017	ND(0.00010)
SP-01	12/31/14	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00012 J	ND(0.00010)
	1/13/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00085	0.00013	ND(0.00010)
	1/21/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0013	ND(0.00010)	ND(0.00010)
	1/30/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0018	0.00017	ND(0.00010)
	2/5/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0017	0.00011	ND(0.00010)
	2/12/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
	2/20/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
	2/25/15	ND(0.00010)	ND(0.00010)	0.00010	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00017	ND(0.00010)
	3/9/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
SP-02	12/31/14	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00011 J	ND(0.00010)
	1/13/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
	1/21/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.00080	ND(0.00010)	ND(0.00010)
	1/30/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0012	0.00017	ND(0.00010)
	2/5/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	0.0010	ND(0.00010)	ND(0.00010)
	2/12/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
	2/20/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
	2/25/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
	3/9/15	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)	ND(0.00010)
Limit for Discharge to Village of Hartford CSS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

- SP-00 - Collected following filtration but prior to the first granular activated carbon treatment vessel
- SP-01 - Collected from the effluent of the first granular activated carbon treatment vessel
- SP-02 - Collected from the effluent of the second granular activated carbon treatment system prior to discharge to the Village of Hartford CSS

CSS - combined sewer system

J - estimated concentration

mg/L - milligrams per liter

NA - not applicable

ND(0.0001) - not detected at the indicated reporting limit

TABLE 4. GROUNDWATER TREATMENT SYSTEM OPERATIONS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Date/Time	Elapsed Time (hours)	Average Flowrate (gpm)	HPW-01 (ft-amsl)	HLRW-01 (ft-amsl)	PZ-01 (ft-amsl)	PZ-02 (ft-amsl)	PZ-03 (ft-amsl)
1/9/15 7:27	0.0	NA	398.5	398.45	398.48	399.51	398.52
1/9/15 11:08	3.7	NA	397.0	398.07	--	--	--
1/9/15 11:32	4.1	NA	397.1	398.05	--	--	--
1/9/15 11:50	4.4	105.6	397.1	398.04	--	--	--
1/9/15 12:13	4.8	102.2	397.1	398.02	--	--	--
1/9/15 12:42	5.3	77.6	397.7	398.19	--	--	--
1/9/15 12:50	5.4	56.3	397.7	398.20	--	--	--
1/9/15 13:03	5.6	56.9	397.7	398.20	--	--	--
1/9/15 13:13	5.8	56.0	397.7	398.20	--	--	--
1/9/15 13:38	6.2	56.4	397.7	398.20	--	--	--
1/9/15 13:47	6.3	90.0	397.1	398.07	--	--	--
1/9/15 14:02	6.6	102.0	397.1	398.02	--	--	--
1/9/15 14:25	7.0	100.0	397.1	398.02	--	--	--
1/9/15 15:18	7.8	99.2	397.1	398.01	--	--	--
1/9/15 15:36	8.2	95.6	397.1	398.00	--	--	--
1/9/15 15:55	8.5	100.8	397.0	397.97	--	--	--
1/9/15 16:10	8.7	94.3	397.0	397.97	--	--	--
1/9/15 16:28	9.0	171.4	396.2	397.72	--	--	--
1/9/15 16:45	9.3	157.9	396.2	397.71	--	--	--
1/9/15 17:00	9.6	157.7	396.2	397.69	--	--	--
1/9/15 17:15	9.8	157.7	396.2	397.69	--	--	--
1/10/15 7:27	24.0	157.5	396.0	397.57	--	--	--
1/10/15 8:03	24.6	183.9	395.5	397.41	--	--	--
1/10/15 8:47	25.3	194.8	395.4	397.38	--	--	--
1/10/15 9:04	25.6	195.9	395.4	397.37	--	--	--
1/10/15 9:24	26.0	199.5	395.4	397.36	--	--	--
1/10/15 9:45	26.3	201.2	395.4	397.36	--	--	--
1/10/15 10:00	26.5	199.7	395.4	397.36	--	--	--
1/10/15 10:23	26.9	197.8	395.5	397.37	--	--	--
1/10/15 10:34	27.1	242.7	394.6	397.18	--	--	--
1/10/15 11:11	27.7	258.6	394.5	397.14	--	--	--
1/10/15 11:33	28.1	258.6	394.5	397.14	--	--	--
1/10/15 12:31	29.1	259.1	394.5	397.13	--	--	--
1/10/15 12:35	29.1	285.0	393.8	397.02	--	--	--
1/10/15 13:42	30.2	325.5	393.8	396.91	--	--	--
1/10/15 13:54	30.5	310.0	393.8	396.91	--	--	--
1/10/15 14:25	31.0	272.9	393.8	396.91	--	--	--
1/10/15 15:10	31.7	307.6	393.7	396.88	--	--	--

TABLE 4. GROUNDWATER TREATMENT SYSTEM OPERATIONS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Date/Time	Elapsed Time (hours)	Average Flowrate (gpm)	HPW-01 (ft-amsl)	HLRW-01 (ft-amsl)	PZ-01 (ft-amsl)	PZ-02 (ft-amsl)	PZ-03 (ft-amsl)
1/11/2015 8:31	49.1	307.3	393.5	396.67	396.50	396.53	396.63
1/11/2015 11:37	52.2	306.7	393.5	396.65	--	--	--
1/11/2015 15:36	56.2	307.4	393.5	396.64	--	--	--
1/12/2015 8:01	72.6	308.9	393.3	396.45	--	--	--
1/12/2015 10:25	75.0	291.8	393.3	396.42	--	--	--
1/12/2015 11:03	75.6	308.4	393.3	396.41	--	--	--
1/12/2015 15:31	80.1	308.1	393.3	396.41	--	--	--
1/13/2015 7:46	96.3	308.8	393.2	396.32	--	--	--
1/13/2015 14:45	103	308.6	393.3	396.37	396.20	396.23	396.31
1/14/2015 7:01	120	308.6	393.2	396.32	--	--	--
1/14/2015 15:29	128	308.5	393.2	396.35	--	--	--
1/15/2015 7:22	144	308.0	393.1	396.28	396.16	396.19	396.28
1/15/2015 12:35	149	260.2	393.2	NA	--	--	--
1/15/2015 13:12	150	306.9	393.2	NA	--	--	--
1/16/2015 7:57	169	307.1	393.0	NA	396.03	396.06	396.13
1/16/2015 14:33	175	306.9	393.1	396.87	--	--	--
1/17/2015 8:08	193	306.9	393.0	396.23	395.98	396.11	396.18
1/17/2015 16:11	201	306.8	393.0	396.20	396.03	396.07	396.14
1/18/2015 8:06	217	307.1	392.9	396.06	395.91	395.94	396.01
1/18/2015 16:02	225	306.8	392.9	396.06	--	--	--
1/19/2015 7:34	240	306.7	392.8	396.01	395.87	395.91	395.86
1/19/2015 15:50	248	306.8	392.8	396.03	395.88	395.92	395.97
1/20/2015 8:30	265	307.7	392.7	395.92	395.76	395.80	395.87
1/20/2015 15:00	272	305.4	392.7	395.90	395.75	395.79	395.86
1/21/2015 7:58	289	305.6	392.6	395.81	395.66	395.71	395.77
1/21/2015 16:20	297	308.8	392.6	395.78	395.62	395.67	395.73
1/22/2015 9:05	314	304.9	392.5	395.70	395.56	395.71	395.67
1/22/2015 16:20	321	305.4	392.6	395.80	395.66	395.71	395.77
1/23/2015 9:47	338	306.4	392.5	395.76	395.62	395.67	395.73
1/23/2015 16:22	345	307.0	392.6	395.82	395.70	395.73	395.80
1/24/2015 9:24	362	313.0	392.5	395.76	395.64	395.68	395.75
1/24/2015 16:07	369	289.0	392.6	395.80	395.69	395.73	395.79
1/25/2015 11:44	388	305.7	392.5	395.74	395.63	395.67	395.73
1/25/2015 16:43	393	306.0	392.3	395.61	395.49	395.53	395.59
1/26/2015 7:50	408	305.8	392.3	395.56	395.44	395.49	395.54
1/26/2015 16:40	417	304.8	392.4	395.64	395.52	395.56	395.62
1/27/2015 11:30	436	305.7	392.2	395.49	395.36	395.41	395.48
1/27/2015 16:27	441	304.7	392.2	395.49	395.35	395.40	395.46
1/28/2015 8:30	457	306.1	392.2	395.48	395.38	395.42	395.48

**TABLE 4. GROUNDWATER TREATMENT SYSTEM OPERATIONS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS**

Date/Time	Elapsed Time (hours)	Average Flowrate (gpm)	HPW-01 (ft-amsl)	HLRW-01 (ft-amsl)	PZ-01 (ft-amsl)	PZ-02 (ft-amsl)	PZ-03 (ft-amsl)
1/28/2015 16:33	465	306.1	392.4	395.63	395.53	395.56	395.62
1/29/2015 8:03	481	305.6	392.2	395.45	395.34	395.39	395.44
1/29/2015 15:36	488	308.7	392.1	395.39	395.27	395.31	395.38
1/30/2015 8:05	505	305.4	392.1	395.34	395.24	395.27	395.33
1/30/2015 16:24	513	305.2	392.2	395.45	395.32	395.38	395.42
1/31/2015 11:01	532	305.3	392.2	395.45	395.33	395.38	395.44
2/1/2015 10:20	555	262.1	392.4	395.66	395.56	395.61	395.66
2/2/2015 8:10	577	306.0	392.0	395.23	395.18	395.21	395.25
2/2/2015 18:11	587	305.2	392.1	395.32	395.26	395.28	395.32
2/3/2015 8:18	601	305.9	392.1	395.33	395.25	395.26	395.32
2/3/2015 17:00	610	305.4	392.2	395.42	395.36	395.38	395.41
2/4/2015 8:19	625	305.7	392.1	395.33	395.26	395.28	395.31
2/4/2015 15:32	632	305.1	392.0	395.25	395.17	395.18	395.22
2/5/2015 8:15	649	305.7	391.9	395.19	395.11	395.14	395.17
2/5/2015 17:29	658	305.4	392.1	395.31	395.24	395.26	395.31
2/6/2015 8:12	673	305.5	392.1	395.32	395.25	395.27	395.32
2/6/2015 16:11	681	304.8	392.2	395.43	395.35	395.38	395.42
2/7/2015 8:12	697	305.0	392.1	395.38	395.31	395.33	395.37
2/7/2015 17:57	707	286.0	392.2	395.44	395.38	395.38	395.42
2/8/2015 7:51	720	305.2	392.1	395.36	395.31	395.33	395.37
2/9/2015 7:33	744	295.7	392.0	395.13	395.06	395.10	395.13
2/9/2015 15:31	752	304.4	392.0	395.16	395.09	395.11	395.14
2/10/2015 8:19	769	304.9	392.0	395.19	395.08	395.13	395.17
2/10/2015 16:06	777	304.3	392.0	395.27	395.20	395.23	395.27
2/11/2015 8:04	793	304.9	392.0	395.22	395.14	395.17	395.21
2/11/2015 16:45	801	312.7	391.6	395.08	395.00	395.01	395.06
2/12/2015 7:57	817	323.4	391.5	394.94	394.86	394.89	394.93
2/12/2015 16:37	825	323.8	391.5	394.98	394.90	394.91	394.97
2/13/2015 8:15	841	330.0	391.6	395.03	394.97	394.99	395.03
2/13/2015 17:05	850	327.5	391.7	395.12	395.04	395.06	395.15
2/14/2015 10:48	867	329.2	391.5	394.99	394.91	394.94	394.98
2/15/2015 10:38	891	329.2	391.4	394.91	394.84	394.86	394.90
2/16/2015 8:26	913	329.3	391.6	395.02	394.96	394.98	395.02
2/16/2015 16:51	921	331.3	391.6	395.02	394.96	394.98	394.02
2/17/2015 8:30	937	328.7	391.5	394.94	394.90	394.91	394.96
2/17/2015 16:57	946	328.9	391.5	394.97	394.93	394.95	395.00
2/18/2015 7:59	961	328.8	391.4	394.85	394.79	394.82	394.86
2/18/2015 17:00	970	329.2	391.3	394.80	394.75	394.76	394.82
2/19/2015 10:34	987	329.3	391.3	394.79	394.72	394.75	394.78

TABLE 4. GROUNDWATER TREATMENT SYSTEM OPERATIONS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Date/Time	Elapsed Time (hours)	Average Flowrate (gpm)	HPW-01 (ft-amsl)	HLRW-01 (ft-amsl)	PZ-01 (ft-amsl)	PZ-02 (ft-amsl)	PZ-03 (ft-amsl)
2/19/2015 17:13	994	328.3	391.3	394.83	394.77	394.80	394.84
2/20/2015 7:11	1008	329.0	391.3	394.85	394.79	394.82	394.86
2/20/2015 17:38	1018	329.2	391.4	394.94	394.89	394.90	394.95
2/21/2015 9:08	1034	328.7	391.4	394.86	394.81	394.83	394.87
2/21/2015 16:27	1041	326.4	391.3	394.79	394.74	394.77	394.80
2/22/2015 9:43	1058	328.0	391.2	394.65	394.60	394.62	394.65
2/22/2015 16:30	1065	328.3	391.2	394.67	394.62	394.64	394.68
2/23/2015 8:24	1081	329.1	391.1	394.62	394.58	394.60	394.63
2/23/2015 16:29	1089	320*	391.5	394.96	394.89	394.93	394.96
2/24/2015 9:43	1106	320*	391.5	394.91	394.87	394.90	394.94
2/24/2015 16:54	1113	320*	391.5	394.90	394.86	394.89	394.92
2/25/2015 8:31	1129	320*	391.4	394.77	394.73	394.75	394.79
2/25/2015 16:44	1137	320*	391.4	394.79	394.74	394.77	394.80
2/26/2015 7:45	1152	320*	391.2	394.59	394.53	394.57	394.60
2/26/2015 16:58	1162	320*	391.1	394.58	394.52	394.54	394.57
2/27/2015 7:50	1176	320*	391.1	394.52	394.46	394.48	394.52
2/27/2015 15:13	1184	320*	391.2	394.61	394.53	394.55	394.59
2/28/2015 8:59	1202	320*	391.1	394.57	394.50	394.52	394.55
2/28/2015 15:15	1208	320*	391.2	394.62	394.56	394.58	394.62
3/1/2015 10:05	1227	320*	391.1	394.56	394.51	394.52	394.56
3/1/2015 13:00	1230	320*	391.2	394.58	394.51	394.53	394.57
3/1/2015 16:59	1234	320*	391.1	394.56	394.49	394.51	394.55
3/2/2015 7:57	1249	320*	391.0	394.46	394.41	394.43	394.46
3/2/2015 14:52	1255	320*	391.2	394.60	394.53	394.50	394.59
3/3/2015 7:27	1272	321.5	391.3	394.71	394.66	394.68	394.72
3/3/2015 14:30	1279	321.5	391.2	394.65	394.58	394.59	394.64
3/4/2015 7:12	1296	321.3	391.0	394.39	394.31	394.33	394.36
3/4/2015 16:18	1305	321.5	391.0	394.41	394.31	394.34	394.38
3/5/2015 7:10	1320	321.6	390.9	394.37	394.27	394.29	394.33
3/5/2015 15:13	1328	321.8	390.9	394.37	394.28	394.30	394.33
3/6/2015 12:22	1349	83.0	391.4	394.77	394.71	394.74	394.78
3/6/2015 15:23	1352	119.7	391.3	394.66	394.60	394.61	394.67
3/7/2015 8:31	1369	121.4	391.1	394.48	394.41	394.43	394.47
3/7/2015 12:13	1373	126.0	391.1	--	--	--	--
3/7/2015 17:01	1378	120.1	391.1	394.45	394.38	394.40	394.43
3/8/2015 9:42	1394	59.0	391.3	394.75	394.67	394.67	394.72
3/8/2015 13:02	1398	322.8	391.1	--	--	--	--
3/8/2015 17:09	1402	322.8	391.1	394.51	394.44	394.44	394.49
3/9/2015 7:07	1416	322.5	390.9	394.35	394.28	394.29	394.33

TABLE 4. GROUNDWATER TREATMENT SYSTEM OPERATIONS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Date/Time	Elapsed Time (hours)	Average Flowrate (gpm)	HPW-01 (ft-amsl)	HLRW-01 (ft-amsl)	PZ-01 (ft-amsl)	PZ-02 (ft-amsl)	PZ-03 (ft-amsl)
3/9/2015 15:12	1424	322.0	390.9	394.39	394.31	394.33	394.37
3/10/2015 7:29	1440	341.2	390.9	394.38	394.26	394.31	394.35

Notes:

* Between February 23 and March 2 water within the flowmeter in area A froze, approximate flow rate determined via data reported from the Wood River Wastewater Treatment Plant

**Between March 6 and March 8 the submersible pump experienced intermittent outages due to electrical overload associated with transfer pumps

-- - Not measured

ft-amsl - feet above mean sea level

gpm - gallons per minute

TABLE 5. AMBIENT AIR MONITORING ANALYTICAL RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Benzene (µg/m³)	Toluene (µg/m³)	m,p-Xylene (µg/m³)	Propene (µg/m³)	n-Hexane (µg/m³)	n-Heptane (µg/m³)	n-Octane (µg/m³)	n-Nonane (µg/m³)	Ethanol (µg/m³)	Acetone (µg/m³)	Dichloro-difluoro-methane (µg/m³)	Chloro-methane (µg/m³)	Trichloro-fluoro-methane (µg/m³)	Trichloro-trifluoro-ethane (µg/m³)	Carbon Tetrachloride (µg/m³)	Tetrachloro-ethane (µg/m³)	Ethyl Acetate (µg/m³)
Upwind	2/24/15	1.2	1.10	0.72	1.2	2.8	1.7	1.1	0.73	ND (6.0)	ND (6.0)	2.2	0.39	1.2	0.49	0.47	0.22	ND (1.2)
Downwind	2/24/15	1.1	0.95	ND (0.60)	0.99	1.6	0.61	ND (0.60)	ND (0.60)	ND (6.0)	ND (6.0)	2.2	0.37	1.2	0.46	0.46	ND (0.12)	ND (1.2)
RPD		-0.087	-0.15	-0.18	-0.19	-0.55	-0.94	-0.59	-0.20	--	--	0.0	-0.053	0.0	-0.063	-0.022	-0.59	--
Upwind	3/5/15	0.93	0.66	ND (0.63)	ND (0.63)	1.4	ND (0.63)	ND (0.63)	ND (0.63)	ND (6.3)	ND (6.3)	2.1	0.37	1.2	0.46	0.44	ND (0.13)	2.0
Downwind	3/5/15	1.4	0.60	ND (0.67)	ND (0.67)	1.4	ND (0.67)	ND (0.67)	ND (0.67)	ND (6.7)	ND (6.7)	2.0	0.35	1.2	0.47	0.45	ND (0.13)	ND (1.3)
RPD		**0.40**	-0.072	--	--	0.0	--	--	--	--	--	-0.049	-0.056	0.0	0.022	0.022	--	-0.42

Notes:

- Only detected constituents included in summary table

* Reporting limit for these parameters influenced by low sample volume due to malfunctioning flow controller

µg/m³ - micrograms per cubic meter

RPD - Relative percent difference defined as:

$$RPD = \frac{C_{Downwind} - C_{Upwind}}{(C_{Downwind} + C_{Upwind}) \div 2}$$

Bold values indicate RPD greater than 25%

TABLE 5. AMBIENT AIR MONITORING ANALYTICAL RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Benzene ($\mu g/m^3$)	Toluene ($\mu g/m^3$)	m,p-Xylene ($\mu g/m^3$)	Propene ($\mu g/m^3$)	n-Hexane ($\mu g/m^3$)	n-Heptane ($\mu g/m^3$)	n-Octane ($\mu g/m^3$)	n-Nonane ($\mu g/m^3$)	Ethanol ($\mu g/m^3$)	Acetone ($\mu g/m^3$)	Dichloro-difluoro-methane ($\mu g/m^3$)	Chloro-methane ($\mu g/m^3$)	Trichloro-fluoro-methane ($\mu g/m^3$)	Trichloro-trifluoro-ethane ($\mu g/m^3$)	Carbon Tetrachloride ($\mu g/m^3$)	Tetrachloro-ethane ($\mu g/m^3$)	Ethyl Acetate ($\mu g/m^3$)
Upwind	1/9/15	0.43	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (5.0)	ND (5.0)	2.0	0.44	1.2	0.49	0.22	ND (0.10)	ND (1.0)
Downwind	1/9/15	1.0	1.1	ND (0.60)	ND (0.60)	1.9	ND (0.60)	ND (0.60)	ND (0.60)	ND (6.0)	ND (6.0)	2.0	0.47	1.2	0.49	0.47	ND (0.12)	ND (1.2)
RPD		0.80	0.75	--	--	1.2	--	--	--	--	--	0.0	0.066	0.0	0.0	0.72	--	--
Upwind	1/10/15	0.74	ND (0.62)	ND (0.62)	ND (0.62)	0.80	ND (0.62)	ND (0.62)	ND (0.62)	ND (6.2)	ND (6.2)	2.1	0.54	1.2	0.50	0.48	ND (0.12)	ND (1.2)
Downwind	1/10/15	2.7	0.69	ND (0.64)	ND (0.64)	0.89	ND (0.64)	ND (0.64)	ND (0.64)	ND (6.4)	ND (6.4)	2.3	0.61	1.4	0.54	0.56	ND (0.13)	ND (1.3)
RPD		1.1	0.11	--	--	0.11	--	--	--	--	--	0.091	0.12	0.15	0.077	0.15	--	--
Upwind	1/11/15	0.46	ND (0.62)	ND (0.62)	ND (0.62)	ND (0.62)	ND (0.62)	ND (0.62)	ND (0.62)	ND (6.2)	ND (6.2)	2.0	0.45	1.2	0.48	0.46	ND (0.12)	3.5
Downwind	1/11/15	2.0	0.90	ND (0.67)	ND (0.67)	1.0	ND (0.67)	ND (0.67)	ND (0.67)	ND (6.7)	ND (6.7)	2.0	0.39	1.1	0.50	0.45	ND (0.13)	ND (1.3)
RPD		1.3	0.37	--	--	0.47	--	--	--	--	--	0.0	-0.14	-0.087	0.041	-0.022	--	-0.92
Upwind	1/15/15	13	5.0	1.7	2.6	2.4	1.1	ND (0.67)	ND (0.67)	ND (6.7)	ND (6.7)	1.9	0.43	1.1	0.48	0.42	0.23	ND (1.3)
Downwind	1/15/15	14	5.1	1.7	2.6	2.7	1.2	ND (0.61)	ND (0.61)	7.5	7.1	1.9	0.48	1.1	0.49	0.44	0.21	ND (1.2)
RPD		0.074	0.020	0.0	0.0	0.12	0.087	--	--	0.11	0.058	0.0	0.11	0.0	0.021	0.047	-0.091	--
Upwind	1/21/15	3.2	ND (2.9)*	ND (2.9)*	6.1	3.0	ND (2.9)*	ND (2.9)*	ND (2.9)*	ND (29)*	ND (29)*	ND (2.9)*	2.0	1.2	ND (0.57)*	ND (0.57)*	ND (0.57)*	ND (5.7)
Downwind	1/21/15	3.9	1.90	0.88	1.0	6.8	4.6	3.6	2.9	ND (7.8)	ND (7.8)	2.4	0.74	1.3	0.50	0.50	0.28	ND (1.6)
RPD		0.20	--	--	-1.4	0.78	--	--	--	--	--	--	-0.92	0.080	--	--	--	--
Upwind	1/27/15	2.0	0.89	ND (0.66)	ND (0.66)	1.2	ND (0.66)	ND (0.66)	ND (0.66)	ND (6.6)	ND (6.6)	2.7	0.65	1.4	0.56	0.59	ND (0.13)	ND (1.3)
Downwind	1/27/15	1.2	0.88	ND (0.62)	2.0	1.2	ND (0.62)	ND (0.62)	ND (0.62)	ND (6.2)	ND (6.2)	3.1	0.64	1.5	0.55	0.61	0.31	ND (1.2)
RPD		-0.50	-0.011	--	1.0	0.0	--	--	--	--	--	0.14	-0.016	0.069	-0.018	0.033	0.82	--
Upwind	2/3/15	1.2	ND (0.66)	ND (0.66)	ND (0.66)	1.2	ND (0.66)	ND (0.66)	ND (0.66)	ND (6.6)	ND (6.6)	2.3	0.43	1.3	0.50	0.47	ND (0.13)	ND (1.3)
Downwind	2/3/15	0.67	ND (0.67)	ND (0.67)	ND (0.67)	1.3	ND (0.67)	ND (0.67)	ND (0.67)	ND (6.7)	ND (6.7)	2.3	0.55	1.3	0.51	0.48	ND (0.13)	ND (1.3)
RPD		-0.57	--	--	--	0.080	--	--	--	--	--	0.0	0.24	0.0	0.020	0.021	--	--
Upwind	2/10/15	1.6	0.73	ND (0.60)	ND (0.60)	0.89	ND (0.60)	ND (0.60)	ND (0.60)	ND (6.0)	100	2.0	0.37	1.1	0.45	0.39	ND (0.12)	ND (1.2)
Downwind	2/10/15	2.0	0.77	ND (0.69)	ND (0.69)	0.91	ND (0.69)	ND (0.69)	ND (0.69)	ND (6.9)	ND (6.9)	2.1	0.40	1.2	0.45	0.41	ND (0.14)	ND (1.4)
RPD		0.22	0.053	--	--	0.022	--	--	--	--	-1.7	0.049	0.078	0.087	0.0	0.050	--	--
Upwind	2/17/15	0.72	ND (0.58)	ND (0.58)	ND (0.58)	0.82	ND (0.58)	ND (0.58)	ND (0.58)	ND (5.8)	ND (5.8)	1.6	0.43	1.1	0.51	0.16	ND (0.12)	ND (1.2)
Downwind	2/17/15	0.90	ND (0.56)	ND (0.56)	ND (0.56)	0.70	ND (0.56)	ND (0.56)	ND (0.56)	ND (5.6)	ND (5.6)	1.6	0.43	1.1	0.50	0.41	ND (0.11)	ND (1.1)
RPD		0.22	--	--	--	-0.16	--	--	--	--	--	0.0	0.0	0.0	-0.020	0.88	--	--

TABLE 6. PERFORMANCE MONITORING SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Distance from Production Well (ft)	Stratum	Screen Length (ft)	Screened Interval (ft-amsl)	Manual Gauging	Pressure Transducer	LNAPL Transmissivity Testing	Soil Vapor Extraction Screening	Dissolved Phase Groundwater Monitoring
Groundwater Production Well									
HPW-01	0	Main	20	380.9 - 360.9	X	–	–	–	–
LNAPL Recovery Well									
HLRW-01	10	Main	20	405.9 - 385.9	X	–	–	–	–
Monitoring Location									
PZ-01	3.4	Main Sand	15	400.7 - 385.7	X	X	–	–	–
PZ-02	4.8	Main Sand	15	401.0 - 386.0	X	X	–	–	–
PZ-03	7.1	Main Sand	15	400.7 - 385.7	X	X	–	–	–
MPE-A003	29	Main Sand	19.5	402.1 - 382.6	X	–	–	X	–
ASW-03	39	Multiple Strata	20.0	410.9 - 390.9	X	X	–	–	–
MP-137	45	Main Sand	14.7	401.9 - 387.2	X	X	–	–	X
MPE-A002	58	Main Sand	19.3	401.0 - 381.7	X	–	X	X	–
MP-133	60	Main Sand	9.6	401.9 - 392.3	X	X	–	–	X
HSVE-28S	61	North Olive	4.5	421.1 - 416.6	X	–	–	X	–
HSVE-28D	64	Rand	6.5	410.1 - 403.6	X	–	–	X	–
HMW-44A	69	North Olive	9.7	422.8 - 413.1	X	–	–	–	–
MPE-A001	71	Main Sand	19.5	401.4 - 381.9	X	–	–	X	–
ASW-01	72	Multiple Strata	25.0	415.8 - 390.8	X	X	–	–	–
HMW-044B	74	Rand	4.7	410.8 - 406.1	X	–	–	–	–
MPE-A004	75	Main Sand	19.4	400.5 - 381.1	X	–	–	X	–
HMW-044C	77	Main Sand	14.9	402.6 - 387.7	X	X	–	–	X
HMW-044D	77	Main Sand	4.4	384.8 - 380.4	X	–	–	–	X

TABLE 6. PERFORMANCE MONITORING SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Distance from Production Well (ft)	Stratum	Screen Length (ft)	Screened Interval (ft-amsl)	Manual Gauging	Pressure Transducer	LNAPL Transmissivity Testing	Soil Vapor Extraction Screening	Dissolved Phase Groundwater Monitoring
MP-134	80	Main Sand	14.7	402.4 - 387.7	X	X	--	--	X
ASW-02	88	Multiple Strata	25.0	415.7 - 390.7	X	--	--	--	--
MP-135	91	Main Sand	14.6	401.5 - 386.9	X	X	--	--	X
HSVE-084	94	Main Sand	3.5	410.0 - 406.5	X	--	--	X	--
MP-136	99	Main Sand	14.7	401.9 - 387.2	X	--	--	--	X
MPE-A005	111	Main Sand	19.5	401.0 - 381.5	X	--	--	X	--
HMW-020	117	Multiple Strata	15.3	403.9 - 388.6	X	--	--	--	--
MP-055C	151	Main Sand	14.7	401.5 - 386.8	X	X[1]	X	--	--
MP-097D	189	Main Sand	9.4	398.8 - 389.4	X	--	--	--	--
MP-054C	243	Main Sand	14.7	398.9 - 384.2	X	X	--	--	--
MP-035D	1,024	Main Sand	14.7	402.4 - 387.7	X	X	--	--	--
MP-085D	1,099	Main Sand	9.5	388.4 - 378.9	X	X[1]	--	--	--

Notes:

"X" indicates monitoring performed during pilot test, "--" indicates no monitoring performed within the location

All distances and depths are approximate

[1] - Transducer deployed but data not recoverable

ft - feet

ft-amsl - feet above mean sea level

LNAPL - light non-aqueous phase liquid

TABLE 7. STEP-TEST RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Step n	Discharge Q (gpm)	Discharge^2 Q^2 (gpm^2)	Drawdown s (ft)	Drawdown/ Discharge s/Q (ft/gpm)	Aquifer Loss Coefficient B (ft/gpm)	Well Loss Coefficient C (ft/gpm^2)	Drawdown due to Laminar Flow s_a (ft)	Drawdown due to Turbulent Flow s_w (ft)	Well Efficiency E_w (%)
1	60.6	3,676	0.80	0.013	0.014	8.4E-06	0.84	0.031	96
2	97.4	9,487	1.5	0.015	0.014	8.4E-06	1.3	0.079	94
3	160.4	25,728	2.5	0.016	0.014	8.4E-06	2.2	0.21	91
4	196.1	38,455	3.1	0.016	0.014	8.4E-06	2.7	0.32	89
5	254.8	64,923	4.0	0.016	0.014	8.4E-06	3.5	0.54	87
6	301.4	90,842	4.8	0.016	0.014	8.4E-06	4.2	0.76	85

Notes:

- Discharge (Q) represents an average Q during step, n
- Drawdown (s) represents the maximum observed drawdown during step, n

gpm - gallons per minute

ft - feet

TABLE 8. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
PZ-02	2/20/15	4	Main Sand	430.62	ND	35.80	--	394.82	3.69	1.73	42
	2/25/15			430.62	ND	35.87	--	394.75	3.76	1.72	47
	3/2/15			430.62	ND	36.19	--	394.43	4.08	1.84	52
	3/10/15			430.62	ND	36.31	--	394.31	4.20	1.67	60
	3/11/15			430.62	ND	34.38	--	396.24	2.27	-0.14	61
	3/17/15			430.62	ND	34.00	--	396.62	1.89	0.03	67
	3/23/15			430.62	ND	33.50	--	397.12	1.39	0.04	73
	3/30/15			430.62	ND	33.30	--	397.32	1.19	0.07	80
PZ-03	1/9/15	8	Main Sand	430.26	ND	31.74	--	398.52	--	--	0
	1/13/15			430.26	ND	33.95	--	396.31	2.21	1.38	4
	1/19/15			430.26	ND	34.29	--	395.97	2.55	1.40	10
	1/22/15			430.26	ND	34.61	--	395.65	2.87	1.46	13
	1/30/15			430.26	ND	34.87	--	395.39	3.13	1.44	21
	2/3/15			430.26	ND	34.95	--	395.31	3.21	1.48	25
	2/10/15			430.26	ND	35.02	--	395.24	3.28	1.44	32
	2/20/15			430.26	ND	35.40	--	394.86	3.66	1.67	42
	2/25/15			430.26	ND	35.47	--	394.79	3.73	1.66	47
	3/2/15			430.26	ND	35.80	--	394.46	4.06	1.59	52
	3/10/15			430.26	ND	35.91	--	394.35	4.17	1.60	60
	3/11/15			430.26	ND	34.04	--	396.22	2.30	-0.14	61
	3/17/15			430.26	ND	33.68	--	396.58	1.94	0.05	67
	3/23/15			430.26	ND	33.16	--	397.10	1.42	0.04	73
	3/30/15			430.26	ND	32.95	--	397.31	1.21	0.06	80
HLRW-001	1/9/15	10	Main Sand	433.87	ND	35.42	--	398.45	--	--	0
	1/13/15			433.87	ND	37.50	--	396.37	2.08	1.27	4
	1/19/15			433.87	ND	37.86	--	396.01	2.44	1.31	10
	1/22/15			433.87	ND	38.17	--	395.70	2.75	1.36	13
	1/30/15			433.87	ND	38.45	--	395.42	3.03	1.38	21
	2/3/15			433.87	ND	38.56	--	395.31	3.14	1.43	25
	2/10/15			433.87	ND	38.64	--	395.23	3.22	1.40	32
	2/20/15			433.87	ND	39.02	--	394.85	3.60	1.63	42
	2/25/15			433.87	ND	39.10	--	394.77	3.68	1.63	47
	3/2/15			433.87	ND	39.41	--	394.46	3.99	1.54	52
	3/10/15			433.87	ND	39.48	--	394.39	4.06	1.52	60
	3/11/15			433.87	ND	37.72	--	396.15	2.30	-0.12	61
	3/17/15			433.87	ND	37.32	--	396.55	1.90	0.03	67

TABLE 8. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
HPW-01	1/9/15	0	Main Sand	433.51	ND	35.50	--	398.01	--	--	0
	1/13/15			433.51	ND	40.70	--	392.81	5.20	4.84	4
	1/22/15			433.51	ND	41.50	--	392.01	6.00	5.31	13
	1/30/15			433.51	ND	41.90	--	391.61	6.40	5.45	21
	2/3/15			433.51	ND	41.90	--	391.61	6.40	5.18	25
	2/10/15			433.51	ND	42.00	--	391.51	6.50	5.23	32
	2/20/15			433.51	ND	42.70	--	390.81	7.20	5.82	42
	2/25/15			433.51	ND	42.50	--	391.01	7.00	5.47	47
	3/2/15			433.51	ND	43.00	--	390.51	7.50	5.90	52
	3/10/15			433.51	ND	43.10	--	390.41	7.60	5.59	60
	3/11/15			433.51	ND	37.70	--	395.81	2.20	0.10	61
	3/17/15			433.51	ND	37.32	--	396.19	1.82	-0.16	67
	3/23/15			433.51	ND	36.80	--	396.71	1.30	-0.13	73
	3/30/15			433.51	ND	36.60	--	396.91	1.10	0.16	80
PZ-01	1/9/15	3	Main Sand	430.15	ND	31.67	--	398.48	--	--	0
	1/13/15			430.15	ND	33.95	--	396.20	2.28	1.50	4
	1/19/15			430.15	ND	34.28	--	395.87	2.61	1.50	10
	1/22/15			430.15	ND	34.59	--	395.56	2.92	1.56	13
	1/30/15			430.15	ND	34.85	--	395.30	3.18	1.54	21
	2/3/15			430.15	ND	34.91	--	395.24	3.24	1.56	25
	2/10/15			430.15	ND	35.00	--	395.15	3.33	1.53	32
	2/20/15			430.15	ND	35.36	--	394.79	3.69	1.75	42
	2/25/15			430.15	ND	35.42	--	394.73	3.75	1.73	47
	3/2/15			430.15	ND	35.75	--	394.40	4.08	1.85	52
	3/10/15			430.15	ND	35.89	--	394.26	4.22	1.70	60
	3/11/15			430.15	ND	33.92	--	396.23	2.25	-0.15	61
	3/17/15			430.15	ND	33.55	--	396.60	1.88	0.04	67
	3/23/15			430.15	ND	33.04	--	397.11	1.37	0.04	73
	3/30/15			430.15	ND	32.85	--	397.30	1.18	0.08	80
PZ-02	1/9/15	4	Main Sand	430.62	ND	32.11	--	398.51	--	--	0
	1/13/15			430.62	ND	34.39	--	396.23	2.28	1.48	4
	1/19/15			430.62	ND	34.71	--	395.91	2.60	1.48	10
	1/22/15			430.62	ND	35.02	--	395.60	2.91	1.53	13
	1/30/15			430.62	ND	35.23	--	395.39	3.12	1.46	21
	2/3/15			430.62	ND	35.31	--	395.31	3.20	1.50	25
	2/10/15			430.62	ND	35.44	--	395.18	3.33	1.52	32

TABLE 8. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
MP-133	1/22/15	60	Main Sand	429.48	32.85	32.88	0.03	396.62	2.01	0.88	13
	1/30/15			429.48	ND	33.17	--	396.31	2.32	0.72	21
	2/3/15			429.48	ND	33.50	--	395.98	2.65	1.01	25
	2/10/15			429.48	ND	33.50	--	395.98	2.65	0.89	32
	2/20/15			429.48	ND	33.60	--	395.88	2.75	0.65	42
	2/25/15			429.48	ND	33.37	--	396.11	2.52	0.54	47
	3/2/15			429.48	ND	33.90	--	395.58	3.05	0.66	52
	3/10/15			429.48	ND	34.64	--	394.84	3.79	1.31	60
	3/11/15			429.48	ND	33.14	--	396.34	2.29	-0.07	61
	3/17/15			429.48	ND	32.70	--	396.78	1.85	0.05	67
	3/23/15			429.48	ND	32.16	--	397.32	1.31	0.02	73
	3/30/15			429.48	ND	31.92	--	397.56	1.07	0.01	80
ASW-1	1/9/15	72	Multiple Strata	430.43	ND	31.96	--	398.47	--	--	0
	1/13/15			430.43	ND	33.11	--	397.32	1.15	0.52	4
	1/19/15			430.43	ND	33.49	--	396.94	1.53	0.58	10
	1/22/15			430.43	ND	33.78	--	396.65	1.82	0.61	13
	1/30/15			430.43	ND	34.08	--	396.35	2.12	0.63	21
	2/3/15			430.43	ND	34.20	--	396.23	2.24	0.71	25
	2/10/15			430.43	ND	34.28	--	396.15	2.32	0.68	32
	2/20/15			430.43	ND	34.55	--	395.88	2.59	0.80	42
	2/25/15			430.43	ND	34.67	--	395.76	2.71	0.84	47
	3/2/15			430.43	ND	34.96	--	395.47	3.00	0.73	52
	3/10/15			430.43	ND	35.10	--	395.33	3.14	0.77	60
	3/11/15			430.43	ND	34.09	--	396.34	2.13	-0.11	61
	3/17/15			430.43	ND	33.70	--	396.73	1.74	0.05	67
	3/23/15			430.43	ND	33.20	--	397.23	1.24	0.06	73
	3/30/15			430.43	ND	32.92	--	397.51	0.96	0.01	80
HMW-044C	1/9/15	77	Main Sand	428.21	29.90	29.92	0.02	398.31	--	--	0
	1/13/15			428.21	31.15	31.24	0.09	397.04	1.27	0.58	4
	1/19/15			428.21	31.55	31.60	0.05	396.65	1.66	0.65	10
	1/22/15			428.21	31.87	31.89	0.02	396.34	1.97	0.70	13
	1/30/15			428.21	ND	32.17	--	396.04	2.27	0.72	21
	2/3/15			428.21	32.23	32.25	0.02	395.98	2.33	0.74	25
	2/10/15			428.21	ND	32.30	--	395.91	2.40	0.70	32
	2/20/15			428.21	ND	32.55	--	395.66	2.65	0.80	42
	2/25/15			428.21	ND	32.62	--	395.59	2.72	0.79	47

TABLE 8. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
HLRW-001	3/23/15	10	Main Sand	433.87	ND	36.82	--	397.05	1.40	0.04	73
	3/30/15			433.87	ND	36.60	--	397.27	1.18	0.05	80
ASW-3	1/9/15	39	Multiple Strata	430.51	32.00	32.02	0.02	398.51	--	--	0
	1/13/15			430.51	33.33	33.40	0.07	397.16	1.34	0.63	4
	1/19/15			430.51	33.87	33.90	0.03	396.63	1.87	0.83	10
	1/22/15			430.51	34.12	34.16	0.04	396.38	2.12	0.83	13
	1/30/15			430.51	34.42	34.46	0.04	396.08	2.42	0.85	21
	2/3/15			430.51	ND	34.57	--	395.94	2.57	0.95	25
	2/10/15			430.51	ND	34.68	--	395.83	2.68	0.95	32
	2/20/15			430.51	34.96	34.98	0.02	395.55	2.96	1.08	42
	2/25/15			430.51	ND	35.10	--	395.41	3.10	1.14	47
	3/2/15			430.51	ND	35.42	--	395.09	3.42	1.06	52
	3/10/15			430.51	ND	35.55	--	394.96	3.55	1.09	60
	3/11/15			430.51	ND	34.28	--	396.23	2.28	-0.05	61
	3/17/15			430.51	ND	33.82	--	396.69	1.82	0.04	67
	3/23/15			430.51	ND	33.32	--	397.19	1.32	0.05	73
	3/30/15			430.51	ND	33.01	--	397.50	1.01	-0.03	80
MP-137	1/9/15	45	Main Sand	429.50	ND	30.87	--	398.63	--	--	0
	1/13/15			429.50	ND	32.35	--	397.15	1.48	1.02	4
	1/19/15			429.50	ND	32.78	--	396.72	1.91	1.13	10
	1/22/15			429.50	ND	33.05	--	396.45	2.18	1.14	13
	1/30/15			429.50	ND	33.27	--	396.23	2.40	1.09	21
	2/3/15			429.50	ND	33.40	--	396.10	2.53	1.17	25
	2/10/15			429.50	ND	33.46	--	396.04	2.59	1.12	32
	2/20/15			429.50	ND	33.70	--	395.80	2.83	1.21	42
	2/25/15			429.50	ND	33.80	--	395.70	2.93	1.24	47
	3/2/15			429.50	ND	34.21	--	395.29	3.34	1.24	52
	3/10/15			429.50	ND	34.30	--	395.20	3.43	1.24	60
	3/11/15			429.50	ND	32.75	--	396.75	1.88	-0.19	61
	3/17/15			429.50	ND	32.42	--	397.08	1.55	0.03	67
	3/23/15			429.50	ND	31.96	--	397.54	1.09	0.08	73
	3/30/15			429.50	ND	31.72	--	397.78	0.85	0.07	80
MP-133	1/9/15	60	Main Sand	429.48	ND	30.85	--	398.63	--	--	0
	1/13/15			429.48	32.15	32.17	0.02	397.33	1.30	0.56	4
	1/19/15			429.48	32.56	32.58	0.02	396.92	1.71	0.65	10

TABLE 6. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
ASW-2	1/9/15	68	Multiple Strata	430.36	ND	31.87	--	398.49	--	--	0
	1/13/15			430.36	ND	32.98	--	397.38	1.11	0.45	4
	1/19/15			430.36	ND	33.36	--	397.00	1.49	0.51	10
	1/22/15			430.36	ND	33.64	--	396.72	1.77	0.53	13
	1/30/15			430.36	ND	33.94	--	396.42	2.07	0.55	21
	2/3/15			430.36	ND	34.03	--	396.33	2.16	0.60	25
	2/10/15			430.36	ND	34.13	--	396.23	2.26	0.59	32
	2/20/15			430.36	ND	34.38	--	395.98	2.51	0.69	42
	2/25/15			430.36	ND	34.50	--	395.86	2.63	0.73	47
	3/2/15			430.36	ND	34.83	--	395.53	2.96	0.86	52
	3/10/15			430.36	ND	35.00	--	395.36	3.13	0.74	60
	3/11/15			430.36	ND	34.05	--	396.31	2.18	-0.09	61
	3/17/15			430.36	ND	33.55	--	396.81	1.68	-0.04	67
	3/23/15			430.36	ND	33.16	--	397.20	1.29	0.08	73
	3/30/15			430.36	ND	32.90	--	397.46	1.03	0.05	80
MP-135	1/9/15	91	Main Sand	429.48	ND	30.67	--	398.81	--	--	0
	1/13/15			429.48	ND	31.91	--	397.57	1.24	0.57	4
	1/19/15			429.48	ND	32.27	--	397.21	1.60	0.61	10
	1/22/15			429.48	ND	32.59	--	396.89	1.92	0.67	13
	1/30/15			429.48	ND	32.91	--	396.57	2.24	0.72	21
	2/3/15			429.48	ND	32.93	--	396.55	2.26	0.69	25
	2/10/15			429.48	ND	33.00	--	396.48	2.33	0.65	32
	2/20/15			429.48	ND	33.30	--	396.18	2.63	0.80	42
	2/25/15			429.48	ND	33.38	--	396.10	2.71	0.81	47
	3/2/15			429.48	ND	33.75	--	395.73	3.08	0.77	52
	3/10/15			429.48	ND	33.90	--	395.58	3.23	0.63	60
	3/11/15			429.48	ND	32.82	--	396.66	2.15	-0.13	61
	3/17/15			429.48	ND	32.42	--	397.06	1.75	0.02	67
	3/23/15			429.48	ND	31.95	--	397.53	1.28	0.06	73
	3/30/15			429.48	ND	31.70	--	397.78	1.03	0.04	80
MP-136	1/9/15	99	Main Sand	429.41	30.62	30.82	0.20	398.74	--	--	0
	1/13/15			429.41	31.80	32.14	0.34	397.53	1.21	0.55	4
	1/19/15			429.41	32.19	32.49	0.30	397.15	1.59	0.60	10
	1/22/15			429.41	32.51	32.72	0.21	396.85	1.89	0.64	13
	1/30/15			429.41	32.84	32.94	0.10	396.55	2.20	0.67	21
	2/3/15			429.41	ND	32.86	--	396.55	2.19	0.63	25

TABLE 8. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
HMW-044C	3/2/15	77	Main Sand	428.21	ND	32.95	--	395.26	3.05	0.72	52
	3/10/15			428.21	ND	33.10	--	395.11	3.20	0.77	60
	3/11/15			428.21	ND	32.07	--	396.14	2.17	-0.13	61
	3/17/15			428.21	ND	31.68	--	396.53	1.78	0.03	67
	3/23/15			428.21	ND	31.20	--	397.01	1.30	0.06	73
	3/30/15			428.21	ND	30.96	--	397.25	1.06	0.05	80
HMW-044D	1/9/15	77	Main Sand	429.76	ND	31.35	--	398.41	--	--	0
	1/13/15			429.76	ND	32.66	--	397.10	1.31	0.68	4
	1/19/15			429.76	33.00	33.01	0.01	396.76	1.65	0.70	10
	1/22/15			429.76	ND	33.37	--	396.39	2.02	0.81	13
	1/30/15			429.76	ND	33.65	--	396.11	2.30	0.82	21
	2/3/15			429.76	ND	33.66	--	396.10	2.31	0.78	25
	2/10/15			429.76	ND	33.78	--	395.98	2.43	0.79	32
	2/20/15			429.76	ND	34.07	--	395.69	2.72	0.93	42
	2/25/15			429.76	ND	34.12	--	395.64	2.77	0.91	47
	3/2/15			429.76	ND	34.50	--	395.26	3.15	0.88	52
	3/10/15			429.76	ND	34.64	--	395.12	3.29	0.93	60
	3/11/15			429.76	ND	33.45	--	396.31	2.10	-0.14	61
	3/17/15			429.76	ND	33.08	--	396.68	1.73	0.04	67
	3/23/15			429.76	ND	32.57	--	397.19	1.22	0.04	73
	3/30/15			429.76	ND	32.35	--	397.41	1.00	0.05	80
MP-134	1/9/15	80	Main Sand	429.57	30.80	31.02	0.22	398.72	--	--	0
	1/13/15			429.57	32.08	32.36	0.28	397.43	1.29	0.67	4
	1/19/15			429.57	32.46	32.71	0.25	397.05	1.67	0.72	10
	1/22/15			429.57	32.78	33.03	0.25	396.73	1.99	0.78	13
	1/30/15			429.57	33.06	33.25	0.19	396.47	2.25	0.78	21
	2/3/15			429.57	33.11	33.19	0.08	396.44	2.28	0.76	25
	2/10/15			429.57	33.21	33.50	0.29	396.29	2.43	0.79	32
	2/20/15			429.57	33.50	33.54	0.04	396.06	2.66	0.88	42
	2/25/15			429.57	ND	33.30	--	396.27	2.45	0.59	47
	3/2/15			429.57	33.89	33.93	0.04	395.67	3.05	0.79	52
	3/10/15			429.57	ND	34.05	--	395.52	3.20	0.84	60
	3/11/15			429.57	ND	32.95	--	396.62	2.10	-0.13	61
	3/17/15			429.57	ND	32.60	--	396.97	1.75	0.07	67
	3/23/15			429.57	ND	32.06	--	397.51	1.21	0.04	73
	3/30/15			429.57	ND	31.62	--	397.75	0.97	0.03	80

TABLE 6. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
MP-055C	3/17/15	151	Main Sand	429.67	ND	33.10	–	396.57	1.24	0.03	67
	3/23/15			429.67	ND	32.60	–	397.07	0.74	0.04	73
	3/30/15			429.67	ND	32.38	–	397.29	0.52	0.05	80
MP-097D	1/9/15	189	Main Sand	429.31	ND	30.70	–	398.61	–	–	0
	1/13/15			429.31	31.66	31.74	0.08	397.63	0.98	0.33	4
	1/19/15			429.31	31.99	32.11	0.12	397.29	1.32	0.35	10
	1/22/15			429.31	32.26	32.34	0.08	397.03	1.58	0.35	13
	1/30/15			429.31	32.56	32.58	0.02	396.75	1.86	0.36	21
	2/3/15			429.31	ND	32.61	–	396.70	1.91	0.36	25
	2/10/15			429.31	32.70	32.72	0.02	396.61	2.00	0.34	32
	2/20/15			429.31	ND	32.92	–	396.39	2.22	0.41	42
	2/25/15			429.31	ND	33.00	–	396.31	2.30	0.41	47
	3/2/15			429.31	ND	33.30	–	396.01	2.60	0.31	52
	3/10/15			429.31	ND	33.43	–	395.88	2.73	0.35	60
	3/11/15			429.31	ND	32.78	–	396.53	2.08	-0.19	61
	3/17/15			429.31	ND	32.36	–	396.95	1.66	-0.05	67
	3/23/15			429.31	ND	32.00	–	397.31	1.30	0.10	73
	3/30/15			429.31	ND	31.80	–	397.51	1.10	0.13	80
MP-054C	1/9/15	243	Main Sand	430.07	30.59	34.42	3.83	398.60	--	–	0
	1/13/15			430.07	31.60	35.31	3.71	397.62	0.98	-0.05	4
	1/19/15			430.07	32.93	33.34	0.41	397.05	1.55	0.20	10
	1/22/15			430.07	33.21	33.62	0.41	396.77	1.83	0.22	13
	1/30/15			430.07	33.52	33.92	0.40	396.46	2.14	0.25	21
	2/3/15			430.07	33.58	33.95	0.37	396.40	2.19	0.28	25
	2/10/15			430.07	33.41	34.10	0.69	396.50	2.10	0.05	32
	2/20/15			430.07	33.92	34.28	0.36	396.07	2.53	0.34	42
	2/25/15			430.07	34.00	34.50	0.50	395.96	2.64	0.37	47
	3/2/15			430.07	34.34	34.83	0.49	395.62	2.98	0.31	52
	3/10/15			430.07	ND	34.50	–	395.57	3.03	0.26	60
	3/11/15			430.07	ND	34.02	–	396.05	2.55	-0.10	61
	3/17/15			430.07	ND	33.60	–	396.47	2.13	0.04	67
	3/23/15			430.07	ND	33.09	–	396.98	1.62	0.04	73
	3/30/15			430.07	ND	32.85	–	397.22	1.38	0.03	80
MP-035D	1/9/15	1024	Main Sand	430.43	33.46	34.22	0.76	396.80	–	–	0
	1/13/15			430.43	33.80	34.61	0.81	396.44	0.35	0.08	4

TABLE 6. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
MP-136	2/10/15	99	Main Sand	429.41	ND	32.98	--	396.43	2.31	0.63	32
	2/20/15			429.41	ND	33.24	--	396.17	2.57	0.75	42
	2/25/15			429.41	ND	33.35	--	396.06	2.68	0.78	47
	3/2/15			429.41	ND	33.67	--	395.74	3.00	0.69	52
	3/10/15			429.41	ND	33.80	--	395.61	3.13	0.73	60
	3/11/15			429.41	ND	32.79	--	396.62	2.12	-0.16	61
	3/17/15			429.41	ND	32.45	--	396.96	1.78	0.06	67
	3/23/15			429.41	ND	31.92	--	397.49	1.25	0.04	73
	3/30/15			429.41	ND	31.72	--	397.69	1.05	0.07	80
HMW-020	1/9/15	117	Multiple Strata	430.65	ND	32.32	--	398.33	--	--	0
	1/13/15			430.65	ND	33.31	--	397.34	0.99	0.35	4
	1/19/15			430.65	ND	33.70	--	396.95	1.38	0.42	10
	1/22/15			430.65	ND	33.96	--	396.69	1.64	0.42	13
	1/30/15			430.65	ND	34.25	--	396.40	1.93	0.43	21
	2/3/15			430.65	ND	34.32	--	396.33	2.00	0.46	25
	2/10/15			430.65	ND	34.43	--	396.22	2.11	0.46	32
	2/20/15			430.65	ND	34.68	--	395.97	2.36	0.56	42
	2/25/15			430.65	ND	34.80	--	395.85	2.48	0.60	47
	3/2/15			430.65	ND	35.12	--	395.53	2.80	0.52	52
	3/10/15			430.65	ND	35.22	--	395.43	2.90	0.53	60
	3/11/15			430.65	ND	34.47	--	396.18	2.15	-0.10	61
	3/17/15			430.65	ND	34.04	--	396.61	1.72	0.02	67
	3/23/15			430.65	ND	33.57	--	397.08	1.25	0.06	73
	3/30/15			430.65	ND	33.30	--	397.35	0.98	0.02	80
MP-055C	1/9/15	151	Main Sand	429.67	31.77	32.16	0.39	397.81	--	--	0
	1/13/15			429.67	32.57	32.96	0.39	397.01	0.80	0.65	4
	1/19/15			429.67	32.30	34.11	1.81	396.95	0.86	0.39	10
	1/22/15			429.67	32.72	33.92	1.20	396.67	1.14	0.41	13
	1/30/15			429.67	33.17	33.66	0.49	396.39	1.42	0.42	21
	2/3/15			429.67	33.22	33.63	0.41	396.36	1.45	0.41	25
	2/10/15			429.67	33.40	33.50	0.10	396.25	1.56	0.40	32
	2/20/15			429.67	33.61	33.90	0.29	395.99	1.82	0.51	42
	2/25/15			429.67	33.37	34.00	0.63	396.16	1.66	0.27	47
	3/2/15			429.67	34.00	34.58	0.58	395.54	2.27	0.48	52
	3/10/15			429.67	34.14	34.16	0.02	395.53	2.28	0.40	60
	3/11/15			429.67	ND	33.50	--	396.17	1.64	-0.12	61

TABLE 6. AREA A MANUAL FLUID LEVEL MEASUREMENTS AND CORRECTED DRAWDOWN
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date Measured	Distance from Pumping Center (feet)	Hydrostratigraphic Unit	Measuring Point Elevation (ft-amsl)	Depth to LNAPL (ft-bmp)	Depth to Water (ft-bmp)	LNAPL Thickness (feet)	Corrected Water Elevation (ft-amsl)	Uncorrected Drawdown (feet)	Corrected Drawdown (feet)	Days from Start of Focused Pumping
MP-035D	1/19/15	1024	Main Sand	430.43	33.99	35.48	1.49	396.10	0.70	0.10	10
	1/22/15			430.43	34.21	35.74	1.53	395.87	0.93	0.07	13
	1/30/15			430.43	34.46	36.08	1.62	395.60	1.20	0.07	21
	2/3/15			430.43	34.51	36.20	1.69	395.53	1.28	0.09	25
	2/10/15			430.43	34.61	36.36	1.75	395.42	1.38	0.09	32
	2/20/15			430.43	34.81	36.33	1.52	395.27	1.52	0.09	42
	2/25/15			430.43	34.85	ND	--	--	--	--	47
	3/2/15			430.43	35.12	37.30	2.18	394.81	1.99	0.07	52
	3/10/15			430.43	35.20	37.49	2.29	394.70	2.09	0.09	60
	3/11/15			430.43	35.10	37.25	2.15	394.84	1.96	0.07	61
	3/17/15			430.43	ND	34.95	--	395.48	1.32	-0.02	67
	3/23/15			430.43	ND	34.45	--	395.98	0.82	-0.01	73
	3/30/15			430.43	ND	34.18	--	396.25	0.55	-0.05	80
MP-065D	1/9/15	1099	Main Sand	427.86	ND	30.67	--	397.19	--	--	0
	1/13/15			427.86	ND	31.00	--	396.86	0.33	-0.08	4
	1/19/15			427.86	ND	31.30	--	396.56	0.63	-0.10	10
	1/22/15			427.86	ND	31.59	--	396.27	0.92	-0.07	13
	1/30/15			427.86	ND	31.87	--	395.99	1.20	-0.07	21
	2/3/15			427.86	ND	31.89	--	395.97	1.22	-0.09	25
	2/10/15			427.86	ND	32.00	--	395.86	1.33	-0.09	32
	2/20/15			427.86	ND	32.15	--	395.71	1.48	-0.09	42
	2/25/15			427.86	ND	32.25	--	395.61	1.58	-0.07	47
	3/2/15			427.86	ND	32.65	--	395.21	1.98	-0.07	52
	3/10/15			427.86	ND	32.73	--	395.13	2.06	-0.09	60
	3/11/15			427.86	ND	32.62	--	395.24	1.95	-0.07	61
	3/17/15			427.86	ND	32.16	--	395.70	1.49	0.02	67
	3/23/15			427.86	ND	31.64	--	396.22	0.97	0.01	73
	3/30/15			427.86	ND	31.45	--	396.41	0.78	0.05	80

Notes:
- - Not measured
ft-amsl - feet above mean sea level
ft-bmp - feet below measuring point
ND - not detected

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Distance from Production Well (feet)	Measured Vacuum (in-H_2O)	Differential Pressure (in-H_2O)	Temperature (°F)	Flow Rate (scfm)	Total Volatile Concentration (ppmv)	Volatile Petroleum Related Concentration (ppmv)	Mass Removal Rate (gal/day)	Incremental Mass Recovered (gal)	Cumulative Mass Recovered (gal)
MPE-A001	1/6/15	71	129.0	0.00	33	0.0	--	--	0.0	0.0	0.0
	1/8/15		100.0	0.00	31'	0.0	--	--	0.0	0.0	0.0
	1/12/15		82.0	0.41	36	15.5	--	--	--	--	--
	1/14/15		59.0	0.49	39	17.5	--	--	--	--	--
	1/16/15		39.0	0.35	42	15.2	--	--	--	--	--
	1/20/15		23.0	0.59	42	20.1	107,000	64,400	109.1	436	436
	1/22/15		55.0	0.32	42	14.2	95,400	54,900	68.7	137	573
	1/26/15		95.0	0.57	44	17.8	91,800	53,300	82.9	331	905
	1/28/15		104.0	0.60	45	18.0	83,400	55,900	76.1	152	1,057
	1/30/15		98.0	0.62	38	18.6	59,500	42,000	56.1	112	1,169
	2/2/15		71.0	0.62	42	19.3	28,400	21,500	27.8	83	1,253
	2/4/15		68.0	0.58	42	18.7	53,800	35,600	51.0	102	1,355
	2/6/15		64.0	0.55	40	18.4	42,800	31,600	39.9	80	1,435
	2/9/15		56.0	0.45	44	16.8	29,200	19,500	24.9	75	1,509
	2/11/15		50.0	0.57	46	19.0	34,400	27,700	33.1	66	1,576
	2/13/15		62.0	0.55	35	18.5	37,200	29,600	34.9	70	1,645
	2/17/15		86.0	0.58	41	18.3	21,800	16,600	20.2	81	1,726
	2/20/15		83.0	0.65	37	19.5	26,500	20,400	26.2	79	1,805
	2/23/15		74.0	0.58	45	18.5	25,800	20,100	24.2	73	1,878
	2/27/15		57.0	0.58	43	19.0	30,300	23,900	29.2	117	1,994
	3/2/15		53.0	0.57	42	19.0	25,700	20,900	24.8	74	2,069
	3/9/15		33.0	0.45	55	17.1	23,900	20,650	20.7	145	2,214
	3/11/15		39.0	0.40	54	16.0	26,250	23,750	21.3	43	2,256
	3/13/15		80.0	0.19	54	10.4	18,000	14,900	9.5	19	2,275
	3/16/15		75.0	0.42	53	15.6	21,500	17,950	17.0	51	2,326
	3/18/15		79.0	0.55	58	17.7	27,300	24,600	24.5	49	2,375
	3/20/15		87.0	0.42	57	15.3	21,900	17,900	17.0	34	2,409
	3/27/15		93.0	0.58	55	17.8	11,800	8,650	10.7	75	2,484
	3/30/15		99.0	0.33	56	13.3	24,500	21,300	16.5	50	2,533
	4/1/15		84.0	0.06	58	6.1	19,000	14,850	5.9	12	2,545
	4/6/15		119.0	0.07	63	6.2	15,500	11,050	4.9	24	2,570

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Distance from Production Well (feet)	Measured Vacuum (in-H_2O)	Differential Pressure (in-H_2O)	Temperature (°F)	Flow Rate (scfm)	Total Volatile Concentration (ppmv)	Volatile Petroleum Related Concentration (ppmv)	Mass Removal Rate (gal/day)	Incremental Mass Recovered (gal)	Cumulative Mass Recovered (gal)
MPE-A002	1/6/15	58	73.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/8/15		67.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/12/15		75.0	0.00	33	0.0	--	--	0.0	0.0	0.0
	1/14/15		123.0	0.00	30	0.0	--	--	0.0	0.0	0.0
	1/16/15		96.0	0.00	38	0.0	--	--	0.0	0.0	0.0
	1/20/15		57.0	0.00	35	0.0	--	--	0.0	0.0	0.0
	1/22/15		46.0	0.00	35	0.0	--	--	0.0	0.0	0.0
	1/26/15		47.0	0.00	36	0.0	--	--	0.0	0.0	0.0
	1/28/15		110.0	0.00	41	0.0	--	--	0.0	0.0	0.0
	1/30/15		58.0	0.00	44	0.0	--	--	0.0	0.0	0.0
	2/2/15		74.0	0.00	33	0.0	--	--	0.0	0.0	0.0
	2/4/15		53.0	0.00	34	0.0	--	--	0.0	0.0	0.0
	2/6/15		116.0	0.00	37	0.0	--	--	0.0	0.0	0.0
	2/9/15		37.0	0.00	40	0.0	--	--	0.0	0.0	0.0
	2/11/15		60.0	0.00	41	0.0	--	--	0.0	0.0	0.0
	2/13/15		94.0	0.10	38	10.0	138,000	106,600	69.9	140	140
	2/17/15		45.0	0.10	34	9.6	143,000	115,500	69.4	278	417
	2/20/15		50.0	0.10	35	9.6	125,000	85,800	60.9	183	600
	2/23/15		113.0	0.13	34	11.8	135,000	95,400	80.4	241	842
	2/27/15		113.0	0.10	30	10.3	145,000	108,100	75.4	301	1,143
	3/2/15		112.0	0.33	38	19.1	130,000	104,500	126.1	378	1,521
	3/9/15		119.0	0.05	38	7.0	145,000	117,800	51.3	359	1,880
	3/11/15		83.0	0.05	56	6.7	182,000	154,900	61.4	123	2,003
	3/13/15		89.0	0.05	48	6.7	135,000	109,760	46.1	92	2,096
	3/16/15		83.0	0.14	48	11.7	100,000	82,700	59.5	178	2,274
	3/18/15		72.0	0.13	49	11.1	106,000	85,500	59.9	120	2,394
	3/20/15		74.0	0.05	48	6.7	105,000	86,800	35.4	71	2,465
	3/27/15		89.0	0.13	45	9.2	82,800	65,100	38.8	271	2,736
	3/30/15		87.0	0.27	46	13.5	75,300	64,000	51.7	155	2,891
	4/1/15		80.0	0.25	53	13.1	88,500	69,000	58.6	117	3,008
	4/6/15		90.0	0.23	58	12.3	59,200	44,000	36.8	184	3,192

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Distance from Production Well (feet)	Measured Vacuum (in-H_2O)	Differential Pressure (in-H_2O)	Temperature (°F)	Flow Rate (scfm)	Total Volatile Concentration (ppmv)	Volatile Petroleum Related Concentration (ppmv)	Mass Removal Rate (gal/day)	Incremental Mass Recovered (gal)	Cumulative Mass Recovered (gal)
MPE-A003	1/6/15	29	53.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/8/15		47.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/12/15		41.0	0.05	38	5.7	--	--	--	--	--
	1/14/15		123.0	0.00	37	0.0	--	--	0.0	0.0	0.0
	1/20/15		104.0	0.05	51	5.2	103,000	84,700	27.2	109	109
	1/22/15		103.0	0.05	48	5.2	109,000	84,700	28.7	57	166
	1/26/15		95.0	0.05	46	5.3	108,000	85,900	29.0	116	283
	1/28/15		92.0	0.10	51	7.4	122,000	97,500	45.8	92	374
	1/30/15		83.0	0.05	53	5.3	127,000	108,500	34.1	68	442
	2/2/15		79.0	0.05	49	5.4	103,000	88,700	28.2	85	527
	2/4/15		80.0	0.05	49	5.4	97,200	18,400	26.6	53	580
	2/6/15		80.0	0.07	49	6.4	85,800	69,600	27.8	56	636
	2/9/15		74.0	0.14	48	9.1	95,200	78,700	43.9	132	768
	2/11/15		38.0	0.13	45	10.8	83,500	66,800	45.8	92	859
	2/13/15		36.0	0.19	44	13.2	63,400	52,200	42.4	85	944
	2/17/15		33.0	0.18	44	12.8	57,600	49,100	37.4	149	1,094
	2/20/15		47.0	0.30	38	17.1	63,500	49,800	54.9	165	1,258
	2/23/15		66.0	0.28	44	16.7	82,900	71,100	70.2	211	1,469
	2/27/15		65.0	0.29	42	17.0	115,000	100,600	99.2	397	1,866
	3/2/15		58.0	0.41	42	20.2	85,200	74,400	87.4	262	2,128
	3/9/15		55.0	0.33	49	17.9	84,800	74,000	76.9	538	2,666
	3/11/15		86.0	0.14	59	11.6	120,000	108,200	70.8	142	2,808
	3/13/15		96.0	0.17	53	13.1	95,200	84,100	63.2	126	2,934
	3/16/15		102.0	0.11	56	10.4	74,200	67,700	39.2	118	3,052
	3/18/15		104.0	0.07	59	8.1	72,300	64,400	29.8	60	3,112
	3/20/15		109.0	0.09	56	9.4	77,300	68,800	36.8	74	3,185
	3/27/15		113.0	0.07	52	6.4	63,400	55,100	20.4	143	3,328
	3/30/15		113.0	0.05	55	5.3	62,800	57,000	16.8	51	3,379
	4/1/15		119.0	0.05	59	5.2	74,800	66,200	19.8	40	3,419
	4/6/15		117.0	0.05	61	5.2	63,500	56,200	16.8	84	3,503

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Distance from Production Well (feet)	Measured Vacuum (in-H_2O)	Differential Pressure (in-H_2O)	Temperature (°F)	Flow Rate (scfm)	Total Volatile Concentration (ppmv)	Volatile Petroleum Related Concentration (ppmv)	Mass Removal Rate (gal/day)	Incremental Mass Recovered (gal)	Cumulative Mass Recovered (gal)
MPE-A004	1/6/15	75	98.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/8/15		100.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/12/15		35.0	0.00	33	0.0	--	--	0.0	0.0	0.0
	1/14/15		107.0	0.00	34	0.0	--	--	0.0	0.0	0.0
	1/16/15		94.0	0.00	34	0.0	--	--	0.0	0.0	0.0
	1/20/15		95.0	0.00	45	0.0	--	--	0.0	0.0	0.0
	1/22/15		85.0	0.00	43	0.0	--	--	0.0	0.0	0.0
	1/26/15		74.0	0.00	44	0.0	--	--	0.0	0.0	0.0
	1/28/15		68.0	0.00	49	0.0	--	--	0.0	0.0	0.0
	1/30/15		50.0	0.00	42	0.0	--	--	0.0	0.0	0.0
	2/2/15		101.0	0.00	45	0.0	--	--	0.0	0.0	0.0
	2/4/15		98.0	0.05	47	5.2	101,000	85,100	26.6	53	53
	2/6/15		98.0	0.12	45	8.1	96,500	86,300	39.6	79	133
	2/9/15		98.0	0.17	47	9.6	95,600	80,000	46.5	140	272
	2/11/15		93.0	0.12	45	8.2	90,500	80,300	37.6	75	347
	2/13/15		93.0	0.17	42	9.8	75,600	69,100	37.6	75	423
	2/17/15		92.0	0.15	45	9.2	75,800	69,300	35.4	141	564
	2/20/15		90.0	0.14	40	8.9	84,300	76,700	38.0	114	678
	2/23/15		86.0	0.25	43	12.0	94,600	85,500	57.6	173	851
	2/27/15		78.0	0.25	43	12.1	115,000	105,200	70.6	282	1,133
	3/2/15		76.0	0.32	48	13.7	90,800	84,300	63.1	189	1,322
	3/9/15		75.0	0.24	48	11.9	175,000	169,500	105.6	739	2,062
	3/11/15		93.0	0.17	63	9.6	163,000	157,700	79.4	159	2,220
	3/13/15		91.0	0.24	51	11.5	105,000	101,400	61.2	122	2,343
	3/16/15		110.0	0.25	55	11.4	88,500	85,900	51.2	153	2,496
	3/18/15		107.0	0.07	59	6.0	85,600	82,600	26.0	52	2,548
	3/20/15		97.0	0.16	55	9.3	94,800	90,500	44.7	89	2,638
	3/27/15		91.0	0.08	49	7.1	67,600	63,900	24.3	170	2,808
	3/30/15		96.0	0.05	48	5.5	62,500	58,800	17.3	52	2,860
	4/1/15		98.0	0.06	55	6.0	68,500	64,600	20.7	41	2,901
	4/6/15		90.0	0.05	57	5.5	55,200	51,000	15.3	76	2,978

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Distance from Production Well (feet)	Measured Vacuum (in-H_2O)	Differential Pressure (in-H_2O)	Temperature (°F)	Flow Rate (scfm)	Total Volatile Concentration (ppmv)	Volatile Petroleum Related Concentration (ppmv)	Mass Removal Rate (gal/day)	Incremental Mass Recovered (gal)	Cumulative Mass Recovered (gal)
MPE-A005	1/8/15	111	113.0	0.00	0	0.0	--	--	0.0	0.0	0.0
	1/12/15		124.0	0.00	34	0.0	--	--	0.0	0.0	0.0
	1/14/15		84.0	0.00	34	0.0	--	--	0.0	0.0	0.0
	1/16/15		22.0	0.00	38	0.0	--	--	0.0	0.0	0.0
	1/20/15		70.0	0.00	42	0.0	--	--	0.0	0.0	0.0
	1/22/15		58.0	0.00	41	0.0	--	--	0.0	0.0	0.0
	1/26/15		24.0	0.00	40	0.0	--	--	0.0	0.0	0.0
	1/28/15		94.0	0.00	46	0.0	--	--	0.0	0.0	0.0
	1/30/15		85.0	0.00	42	0.0	--	--	0.0	0.0	0.0
	2/2/15		81.0	0.00	36	0.0	--	--	0.0	0.0	0.0
	2/4/15		76.0	0.00	42	0.0	--	--	0.0	0.0	0.0
	2/6/15		66.0	0.00	42	0.0	--	--	0.0	0.0	0.0
	2/9/15		59.0	0.00	46	0.0	--	--	0.0	0.0	0.0
	2/11/15		56.0	0.07	47	6.6	224,000	202,500	75.0	150	150
	2/13/15		104.0	0.00	36	0.0	--	--	0.0	0.0	150
	2/17/15		68.0	0.05	32	5.6	119,000	111,300	33.8	135	285
	2/20/15		64.0	0.05	37	5.6	132,000	126,100	37.5	112	398
	2/23/15		57.0	0.05	37	5.6	137,000	129,800	38.9	117	514
	2/27/15		61.0	0.05	34	5.6	239,000	225,600	67.9	272	786
	3/2/15		63.0	0.06	45	6.1	125,000	119,400	38.7	116	902
	3/9/15		48.0	0.05	43	5.7	250,000	246,500	72.3	506	1,408
	3/11/15		59.0	0.05	57	5.5	305,000	301,300	85.1	170	1,578
	3/13/15		59.0	0.05	57	5.5	140,000	137,200	39.0	78	1,656
	3/16/15		87.0	0.05	52	5.3	177,000	176,100	47.6	143	1,799
	3/18/15		93.0	0.05	57	5.2	207,000	204,900	54.6	109	1,908
	3/20/15		99.0	0.07	55	6.1	176,000	174,200	54.4	109	2,017
	3/27/15		36.0	0.16	49	11.0	166,000	164,700	92.9	650	2,667
	3/30/15		38.0	0.18	49	11.7	176,000	174,100	104.7	314	2,981
	4/1/15		39.0	0.16	54	10.9	225,000	222,400	124.7	249	3,230
	4/6/15		41.0	0.10	58	8.5	153,000	150,500	65.7	329	3,559

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location	Date	Distance from Production Well (feet)	Measured Vacuum (in-H_2O)	Differential Pressure (in-H_2O)	Temperature (°F)	Flow Rate (scfm)	Total Volatile Concentration (ppmv)	Volatile Petroleum Related Concentration (ppmv)	Mass Removal Rate (gal/day)	Incremental Mass Recovered (gal)	Cumulative Mass Recovered (gal)
HSVE-028S	1/6/15	61	127.0	3.48	32[1]	27.9	--	--	--	--	--
	1/8/15		17.0	3.64	31[1]	33.7	--	--	--	--	--
	1/12/15		130.0	3.88	35[1]	29.2	--	--	--	--	--
	1/14/15		130.0	3.72	35[1]	28.6	--	--	--	--	--
	1/16/15		129.0	3.85	32[1]	29.2	--	--	--	--	--
	1/20/15		130.0	3.93	44[1]	29.1	--	--	--	--	--
	1/22/15		130.0	3.96	41[1]	29.3	--	--	--	--	--
	1/26/15		124.0	3.71	41[1]	28.7	26.7	11.6	0.0	0.2	0.2
	1/28/15		126.0	3.67	45[1]	28.3	20.0	9.0	0.0	0.1	0.2
	1/30/15		126.0	3.67	43[1]	28.4	26.3	15.7	0.0	0.1	0.3
	2/2/15		128.0	3.63	39[1]	28.2	32.2	20.3	0.0	0.1	0.4
	2/6/15		129.0	3.72	41[1]	28.5	16.2	8.3	0.0	0.1	0.5
	2/9/15		127.0	4.02	44[1]	29.6	14.0	7.3	0.0	0.1	0.6
	2/11/15		124.0	3.78	44[1]	28.9	12.1	5.8	0.0	0.0	0.6
	2/13/15		124.0	3.76	38[1]	29.0	12.4	9.8	0.0	0.0	0.7
	2/17/15		123.0	3.84	38[1]	29.3	13.7	9.8	0.0	0.1	0.7
	2/20/15		124.0	3.72	35[1]	28.9	20.1	15.2	0.0	0.1	0.8
	2/23/15		125.0	3.60	39[1]	28.3	10.0	5.6	0.0	0.0	0.9
	2/27/15		125.0	3.94	37[1]	29.6	10.0	8.8	0.0	0.1	0.9
	3/2/15		123.0	3.76	41[1]	28.9	12.1	10.9	0.0	0.1	1.0
	3/9/15		125.0	3.83	46[1]	29.0	7.8	7.8	0.0	0.1	1.1
	3/11/15		127.0	3.34	57[1]	26.7	14.3	14.3	0.0	0.0	1.1
	3/13/15		125.0	3.48	52[1]	27.4	7.0	5.2	0.0	0.0	1.1
	3/16/15		128.0	3.36	52[1]	26.8	5.3	5.3	0.0	0.0	1.1
	3/18/15		127.0	3.57	56[1]	27.6	2.2	2.2	0.0	0.0	1.1
	3/20/15		128.0	3.34	54[1]	26.7	2.9	2.9	0.0	0.0	1.2
	3/27/15		128.0	3.22	50[1]	26.3	3.4	3.4	0.0	0.0	1.2
	3/30/15		128.0	3.38	51[1]	26.9	3.4	3.4	0.0	0.0	1.2
	4/1/15		132.0	3.47	56[1]	27.0	4.0	3.0	0.0	0.0	1.2
	4/6/15		128.0	3.47	59[1]	27.1	8.8	3.9	0.0	0.1	1.3

TABLE 9. SOIL VAPOR EXTRACTION SCREENING RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Notes:

a Baseline fluid level measurements collected prior to January 6, 2015 indicated that the screen intervals were occluded and the MPE wells were not operated

b Fluid levels are not included herein as these measurements are affected by vacuum applied to the well and therefore inaccurate

c Operation of HSVE-028D was discontinued by the Hartford Working Group after January 16, 2015 due to silt accumulation within the well

d HSVE-084 did not have measurable air flow at any time during the pilot test and the results are therefore not included herein

e Mass removal rate based on measured total volatile concentration, air flow rate, and assumed LNAPL molecular weight of 95 grams per mol and density of 6.2 lb/gal

[1] Temperature not measured. Average temperature of measured Area A wells used as a surrogate.

– soil vapor sample not collected for screening purposes

°F - degrees Fahrenheit

ft-amsl - feet above mean sea level

gal - gallons

in-H_2O - inches of water

lb/hr - pounds per hour

ppmv - parts per million by volume

scfm - standard cubic feet per minute

TABLE 10. GROUNDWATER ANALYTICAL RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location ID	Date Sampled	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	MTBE (mg/L)
HMW-044C	5/8/14	25 J	2.1 J	0.70 J	5.9 J	ND (0.50)
	1/27/15	24	2.3 J	0.72 J	5.5	ND (1.0)
	2/26/15	37	2.3	0.78	5.5	ND (1.0)
	3/27/15	32	2.0	0.69	4.8	ND (1.0)
	4/28/15	23	1.8	0.58	3.9	ND (1.0)
	5/28/15	25	2.2	0.68	5.4	ND (1.0)
HMW-044D	7/7/14	0.062	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0020)
	1/27/15	0.0010 J	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0020)
	2/24/15	0.0026	ND (0.0050)	ND (0.0050)	0.0012	0.00050
	3/27/15	0.0090	0.0019	ND (0.0050)	0.0032	ND (0.0020)
	4/28/15	0.0028	ND (0.0050)	ND (0.0050)	0.0020	ND (0.0020)
	5/29/15	0.032	0.0092	0.0016	0.023	ND (0.0020)
MP-133	5/8/14	31 J	2.1 J	0.75 J	7.4 J	ND (0.50)
	1/27/15	22	2.1	0.88 J	6.5	ND (0.40)
	2/26/15	41	2.3	1.0	7.6	ND (0.40)
	3/27/15	34	1.9	0.74	6.4	ND (0.40)
	4/29/15	32	2.0	0.78	6.7	ND (1.0)
	5/29/15	35	2.5	0.81	7.7	ND (1.0)
MP-134	5/8/14	26 J	1.6 J	0.49 J	4.6 J	ND (0.50)
	3/26/15	26	1.2	0.31	3.0	ND (0.40)
	4/28/15	29	1.7	0.39	3.8	ND (0.40)
	5/29/15	27	1.7	0.42	3.8	ND (0.40)
MP-135	5/8/14	32 J	1.9 J	0.71 J	5.0 J	ND (0.50)
	1/26/15	20	1.6	0.83 J	4.1	ND (0.40)
	2/24/15	32	1.4	0.63	3.7	ND (0.40)
	3/26/15	27	1.2	0.49	2.8	ND (0.40)
	4/28/15	30	1.9	0.64	3.8	ND (0.40)
	5/29/15	27	1.8	0.56	3.5	ND (0.40)
MP-136	5/8/14	24 J	1.1 J	0.60 J	3.3 J	ND (0.50)
	2/24/15	34	1.6	0.97	5.1	ND (0.40)
	3/26/15	26	0.92	0.45	2.5	ND (0.40)
	4/28/15	27	1.2	0.55	3.4	ND (0.40)
	5/29/15	21	1.1	0.51	3.0	ND (0.40)

TABLE 10. GROUNDWATER ANALYTICAL RESULTS SUMMARY
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS

Location ID	Date Sampled	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes, Total (mg/L)	MTBE (mg/L)
MP-137	5/6/14	19 J	0.91 J	0.74 J	3.1 J	ND (0.50)
	1/26/15	19	1.6	0.71 J	5.4	ND (0.40)
	2/24/15	31	1.2	1.2	4.4	ND (0.40)
	3/27/15	27	0.92	1.7	2.8	ND (0.40)
	4/29/15	26	1.0	0.93	3.0	ND (0.40)
	5/29/15	23	0.93	1.0	2.8	ND (0.40)

Notes:

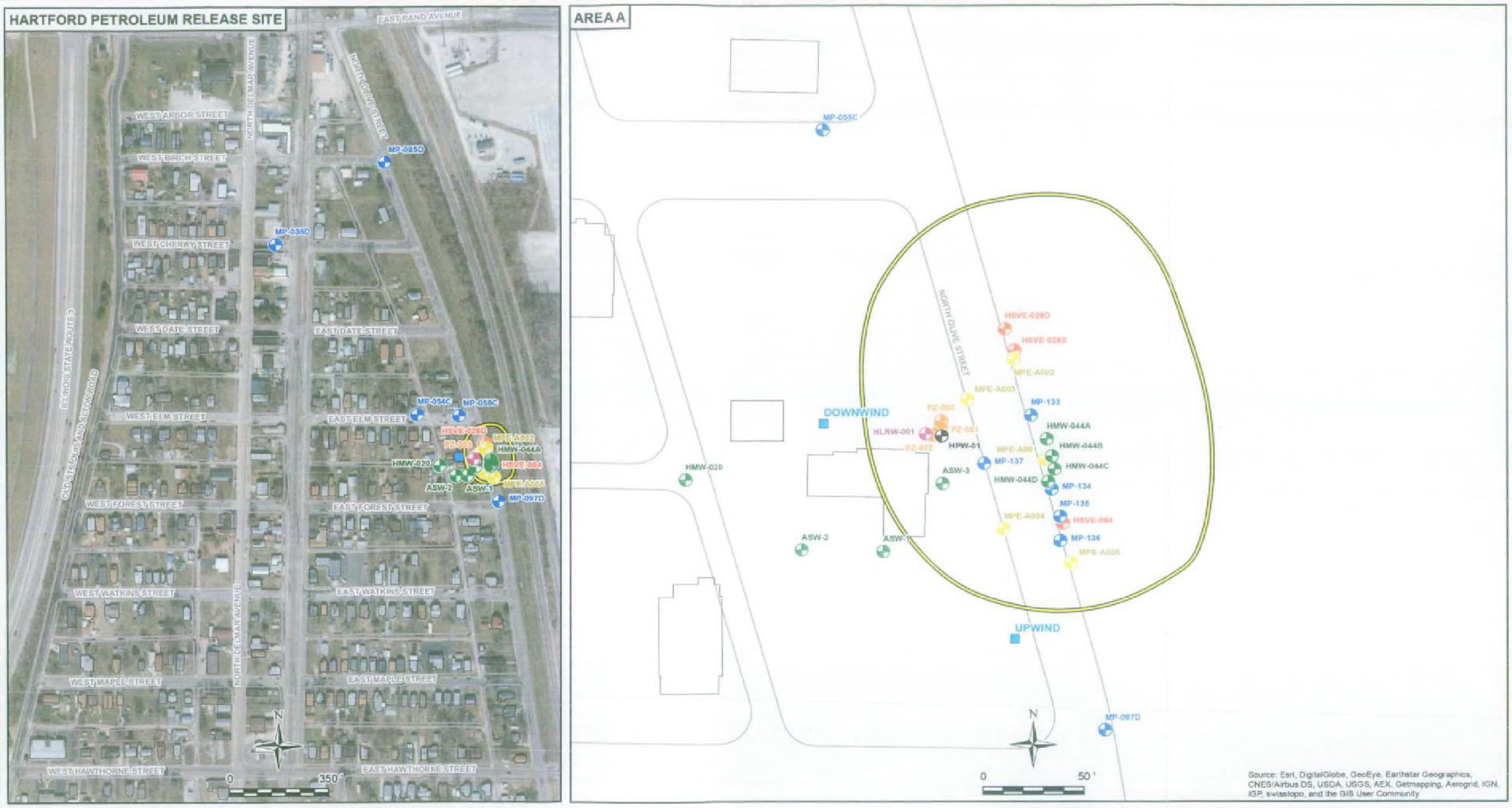
- Groundwater samples were not collected for laboratory analysis if LNAPL was measured within the monitoring location during the monthly monitoring event

J - estimated concentration

MTBE - methyl tert butyl ether

mg/L -milligrams per liter

FIGURES



EXPLANATION

- LNAPL RECOVERY WELL
- GROUNDWATER MONITORING WELL
- MULTIPHASE EXTRACTION WELL
- MULTIPURPOSE MONITORING POINT
- PIEZOMETER
- PRODUCTION WELL
- SOIL VAPOR EXTRACTION WELL
- AIR MONITORING LOCATION
- AREA A
- BUILDING

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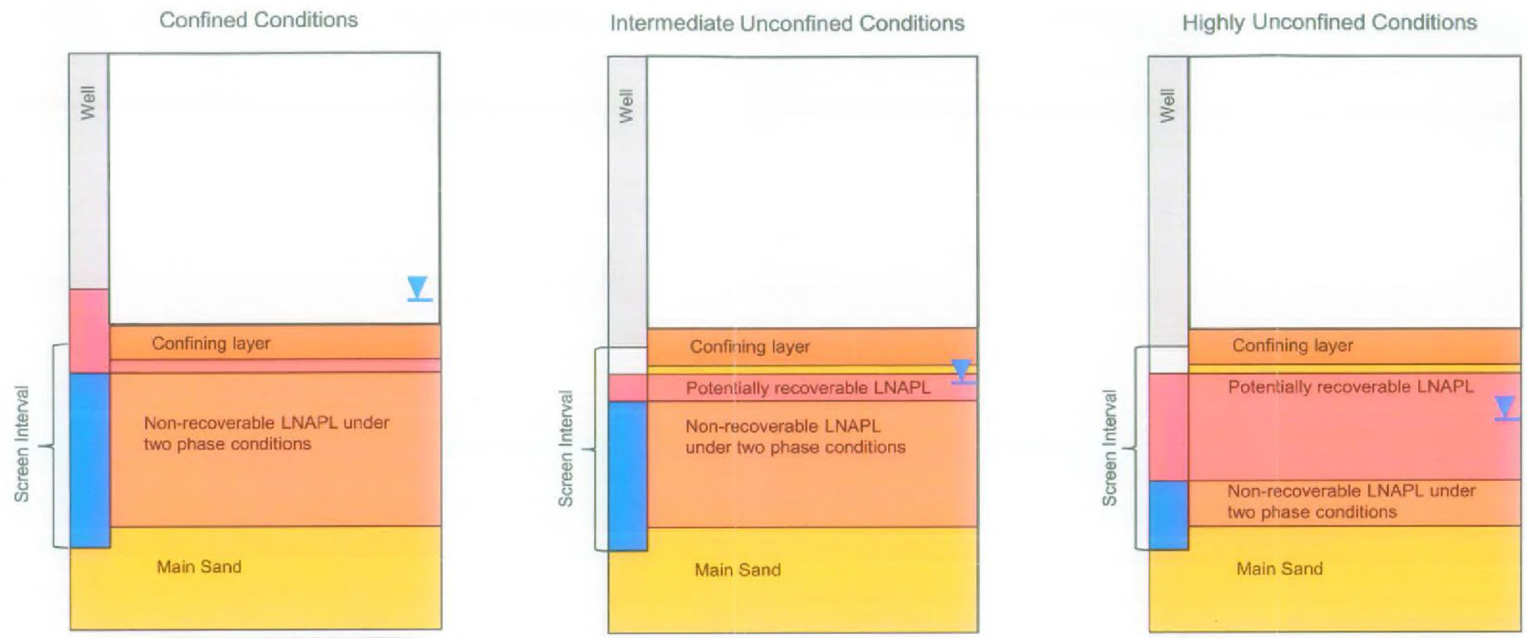
FIGURE 1

SITE LOCATION MAP

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

Drawn By: BR	Checked By: TA	Scale: AS SHOWN	Date: 6/23/15	File: Fig1_AOC_SiteLocREV.mxd



Piezometric surface above the confining clay stratum. LNAPL is confined with an exaggerated thickness in the well. LNAPL can be recovered from thin interval at the top of the smear zone.

Piezometric surface slightly below clay stratum. LNAPL is unconfined and recoverable from interval at the top of the smear zone in the Main Sand.

Water table far below clay stratum. LNAPL is unconfined and recoverable across large vertical interval of smear zone in the Main Sand.

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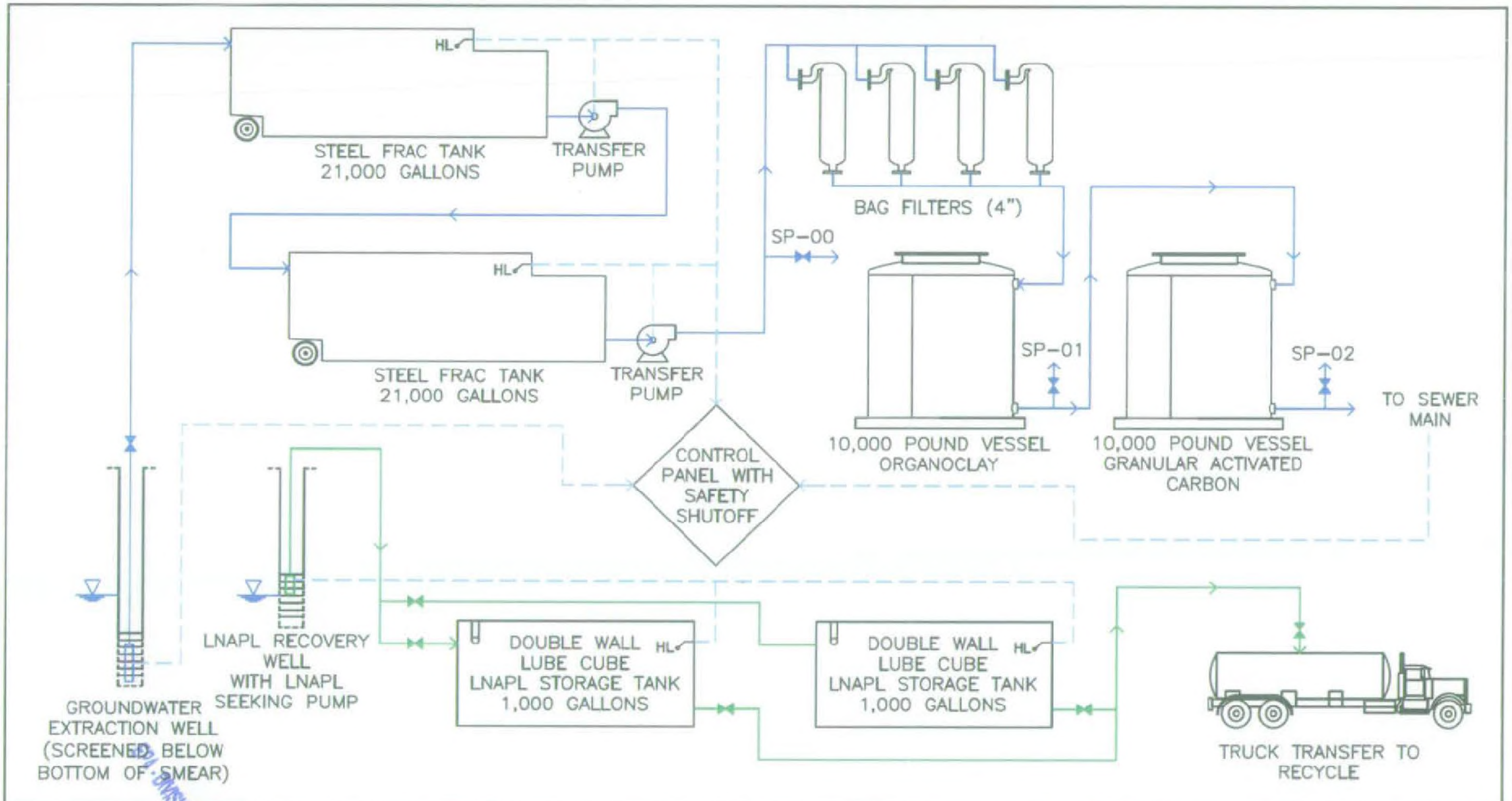
FIGURE 2

SCHEMATIC DIAGRAM OF DUAL OPTIMAL LNAPL RESPONSE MODEL

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

Drawn By: REP	Checked By: BM	Scale: NONE	Date: 2/14/14	File: 24S_DOLRMODEL2014



EXPLANATION

GROUNDWATER FLOW

LNAPL FLOW

CONTROL SYSTEM

HL HIGH LEVEL

SP SAMPLE PORT AND DESIGNATION

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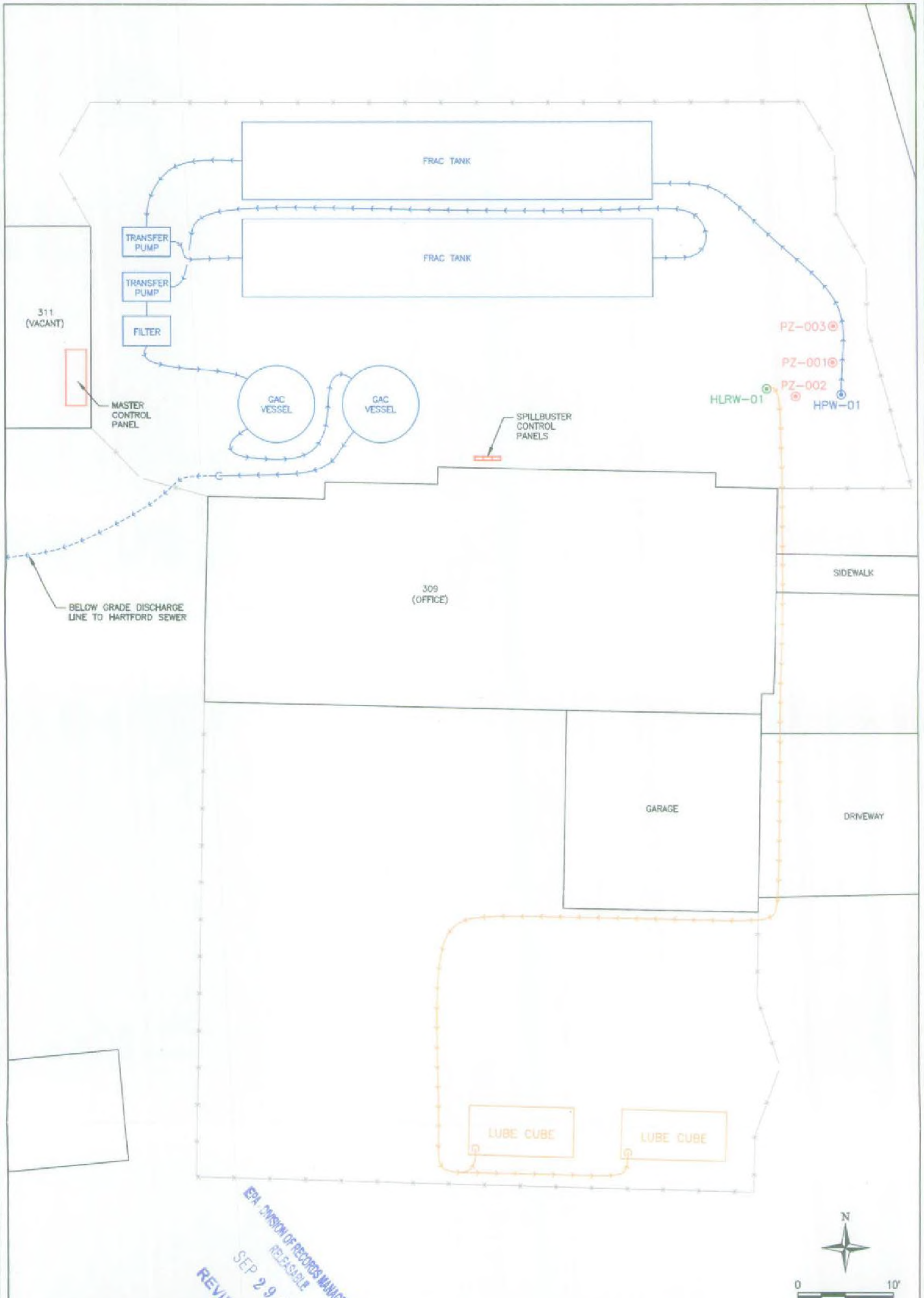
FIGURE 3

PILOT TEST
TREATMENT TRAIN SCHEMATIC

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

Drawn By: REP	Checked By: JLP	Scale: NONE	Date: 5/7/15	File: 24S_PRCSSFLWDIA201505



EXPLANATION

HPW-01	GROUNDWATER RECOVERY WELL
HLRW-01	LNAPL RECOVERY WELL
PZ-01	GROUNDWATER PIEZOMETER
	FLEXIBLE WATER CONVEYANCE LINE (4-INCH)
	LNAPL CONVEYANCE LINE (1-INCH)
	FENCE
GAC	GRANULAR ACTIVATED CARBON

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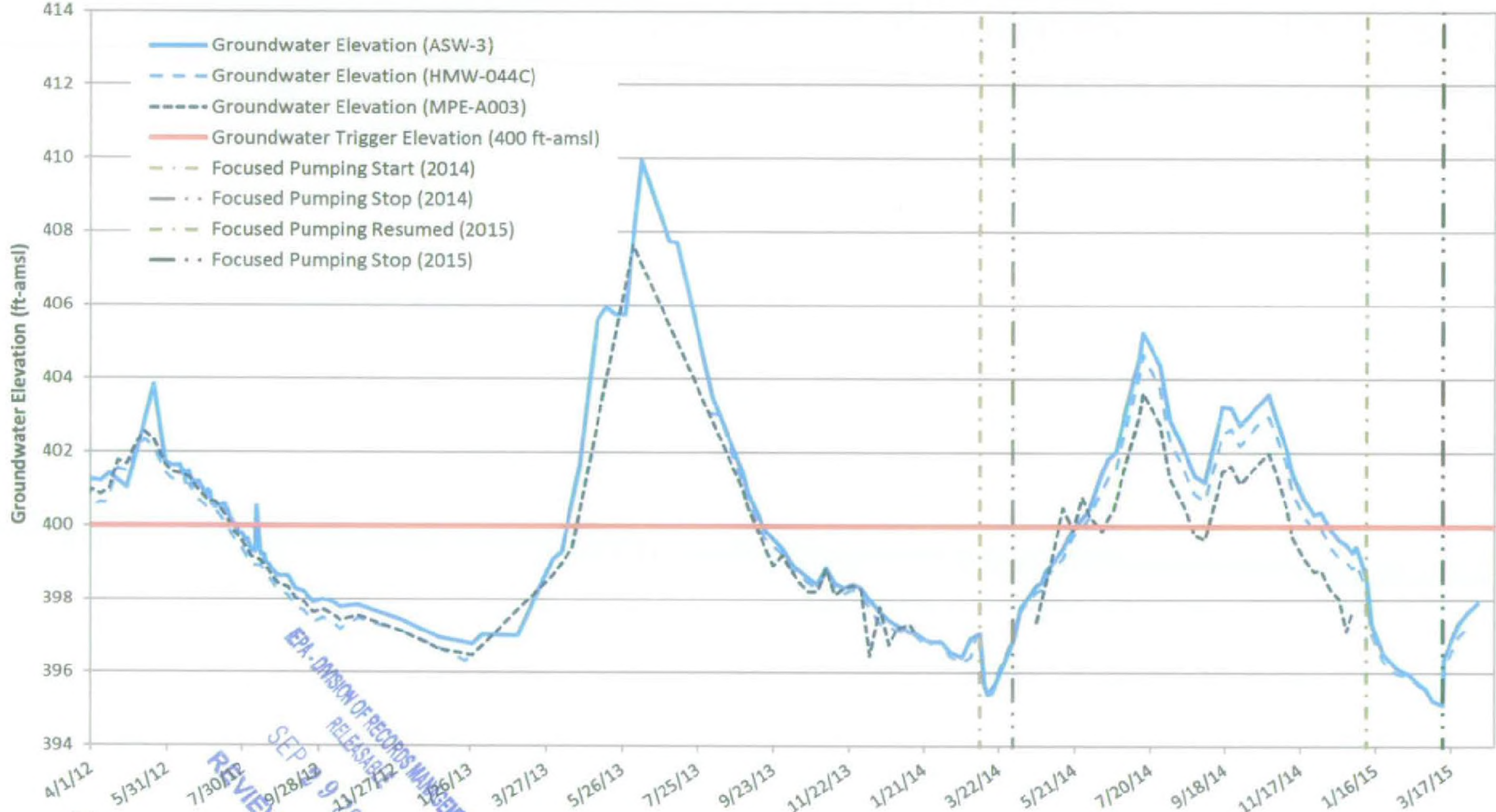
FIGURE 4

TREATMENT AND RECOVERY INFRASTRUCTURE LAYOUT

HARTFORD PETROLEUM RELEASE SITE HARTFORD, ILLINOIS

Drawn By: REP | Checked By: TA | Scale: 1" = 10' | Date: 1/20/15 | File: 24S_ADDINFRA201505

FIGURE 5. AREA A TRIGGER MONITORING WELL HYDROGRAPHS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



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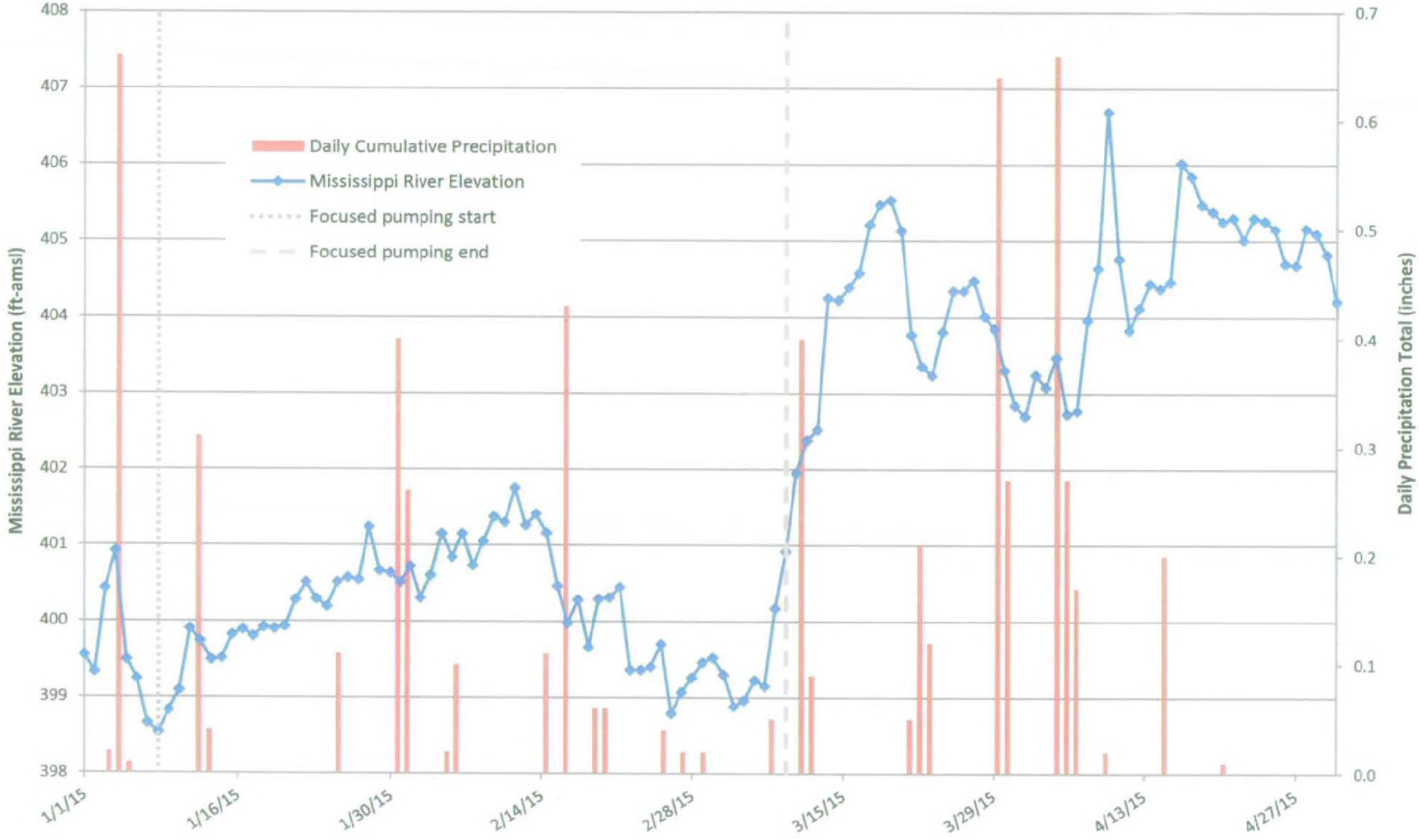
Notes:
- Gauging within well MPE-A003 was suspended between January 13 and April 21, 2014 and after January 6, 2015 during vapor extraction operations
- Gauging measurements within trigger well HMW-044C excluded between January 28 and August 5, 2013 due to gaps in the manual gauging measurements compared to the two other trigger wells

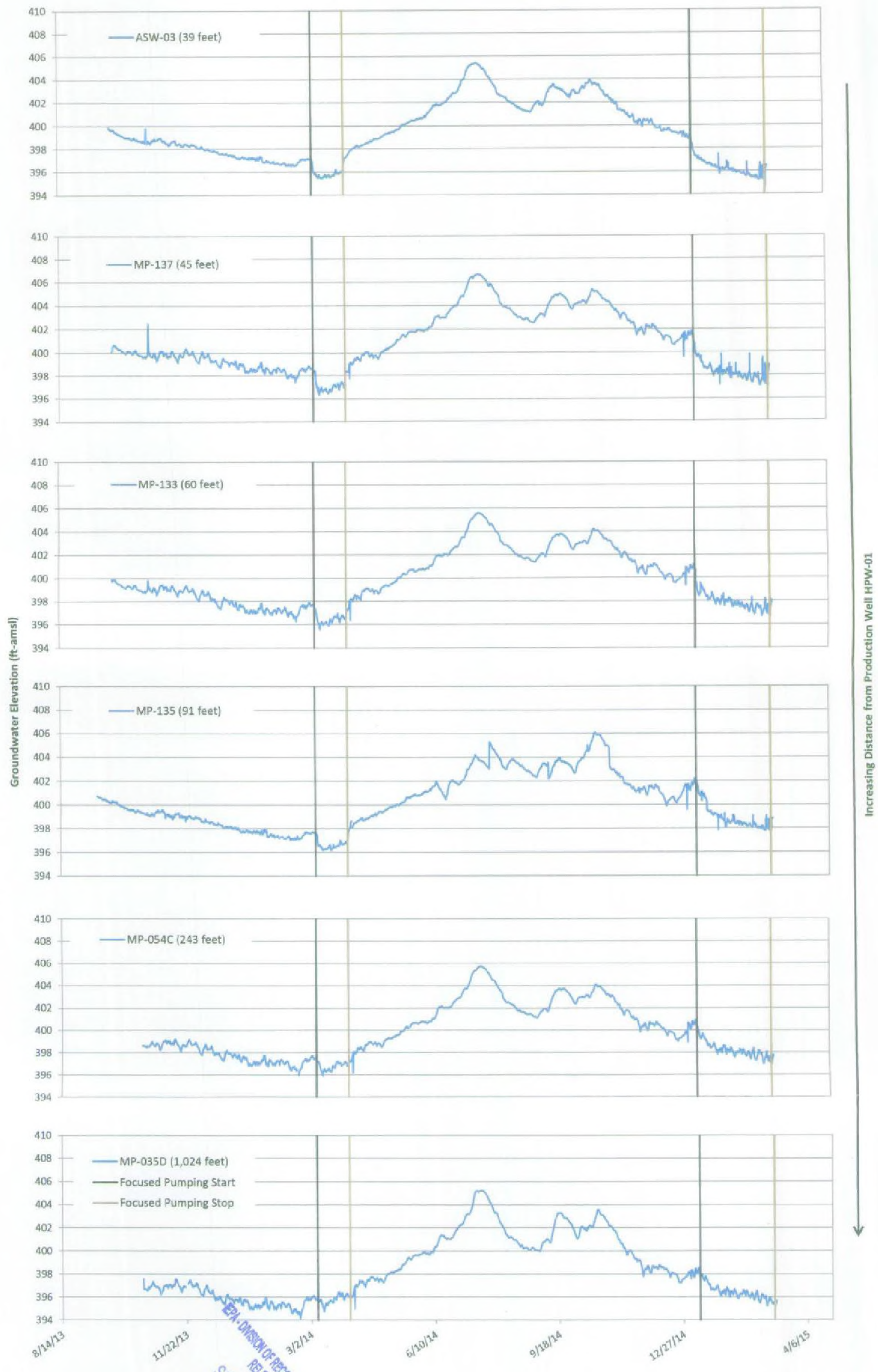
201506-05_TriggerTracking_Fig-5

FIGURE 6. RIVER STAGE ELEVATION AND DAILY PRECIPITATION
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



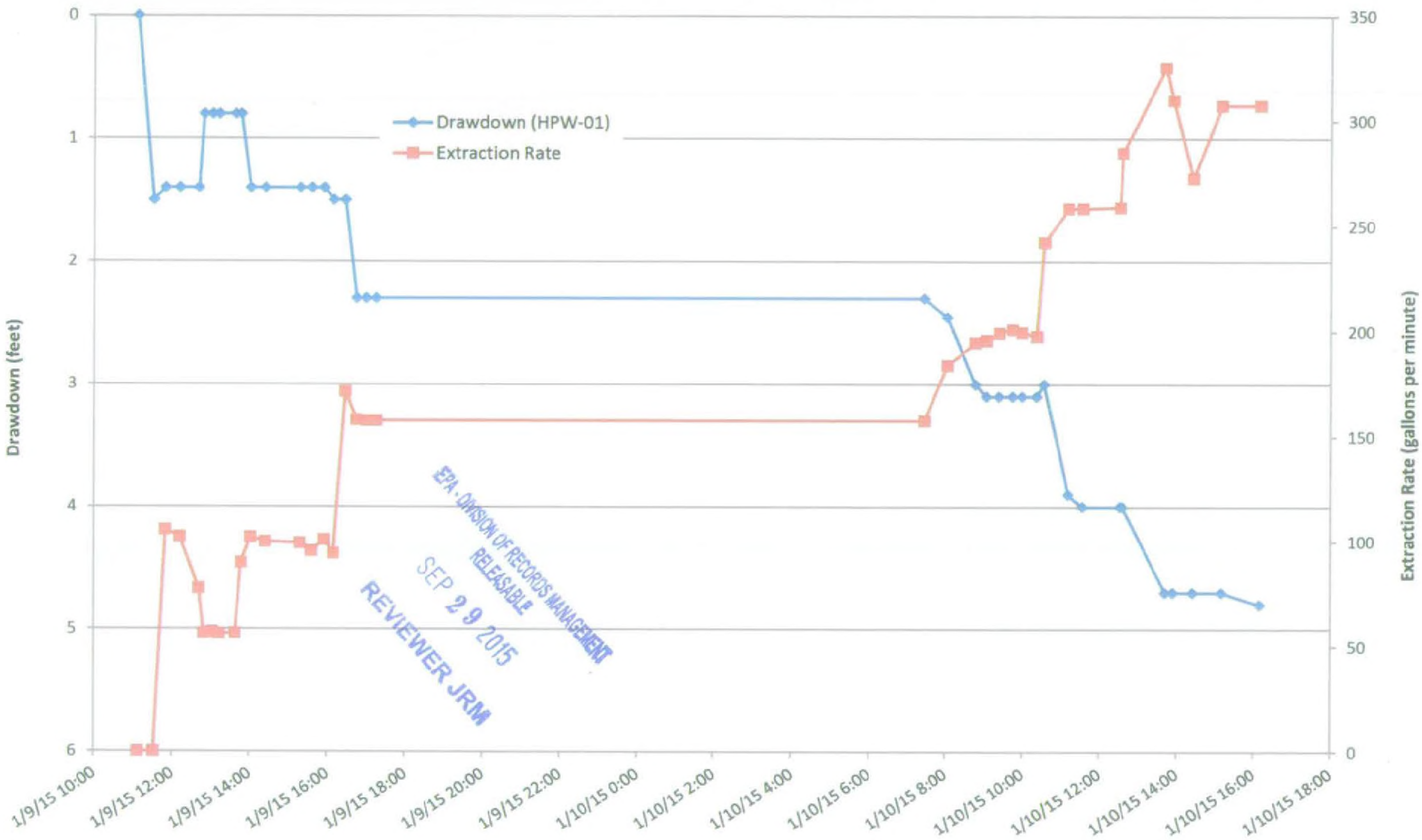
201506-06_Precip-RiverStage_FIG-6

FIGURE 7. HYDROGRAPHS OF PRESSURE TRANSDUCER RESULTS FROM SELECT MONITORING LOCATIONS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



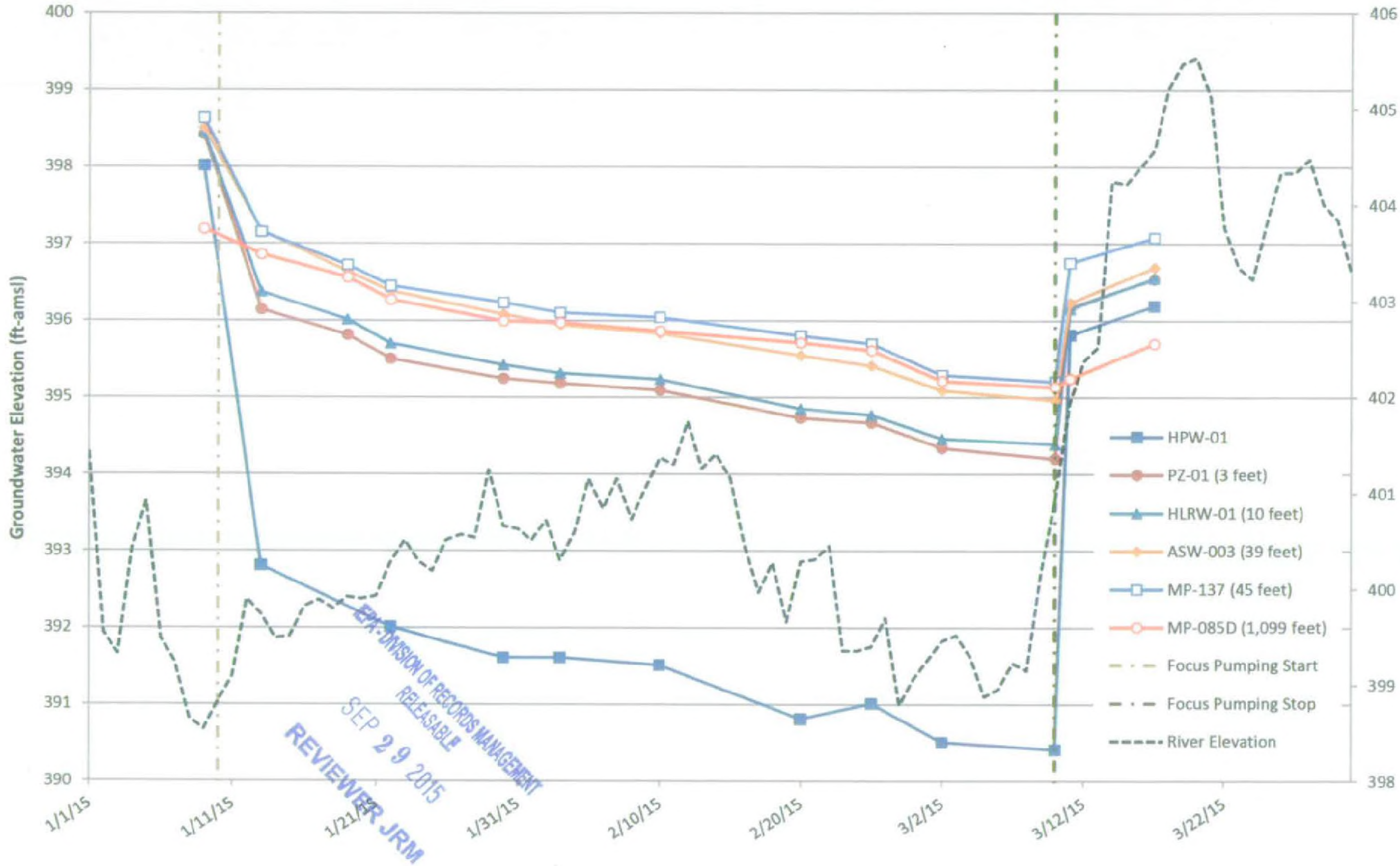
201506-07_TransducerHydrographs_FIG-7

FIGURE 8. STEP TEST RESULTS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



201505_StepTestResults_FIG-8

FIGURE 9. HYDROGRAPHS OF MANUAL MEASUREMENTS IN SELECT MONITORING LOCATIONS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



201505_TransducerData_Fig-9

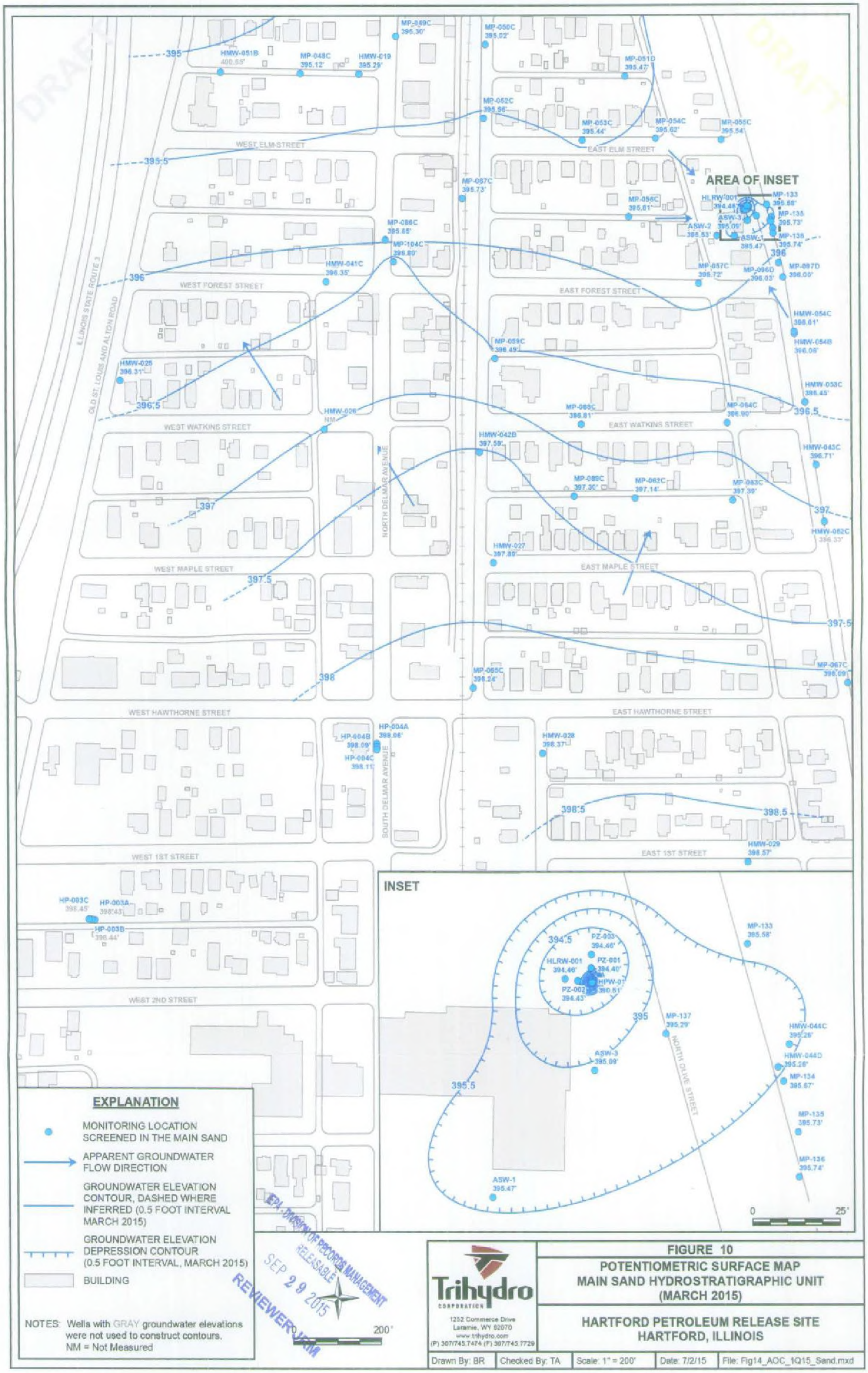

AREA OF INSET
INSET
WEST ELM STREET
EAST ELM STREET
WEST FOREST STREET
EAST FOREST STREET
WEST WATKINS STREET
EAST WATKINS STREET
WEST MAPLE STREET
EAST MAPLE STREET
WEST HAWTHORNE STREET
EAST HAWTHORNE STREET
WEST 1ST STREET
EAST 1ST STREET
WEST 2ND STREET
NORTH DELMAR AVENUE
SOUTH DELMAR AVENUE
OLD ST. LOUIS AND ALTON ROAD
ILLINOIS STATE ROUTE 3
NORTH OLIVE STREET
DRAFT
EXPLANATION
MONITORING LOCATION SCREENED IN THE MAIN SAND
APPARENT GROUNDWATER FLOW DIRECTION
GROUNDWATER ELEVATION CONTOUR, DASHED WHERE INFERRED (0.5 FOOT INTERVAL MARCH 2015)
GROUNDWATER ELEVATION DEPRESSION CONTOUR (0.5 FOOT INTERVAL, MARCH 2015)
BUILDING
NOTES: Wells with GRAY groundwater elevations were not used to construct contours.
NM = Not Measured
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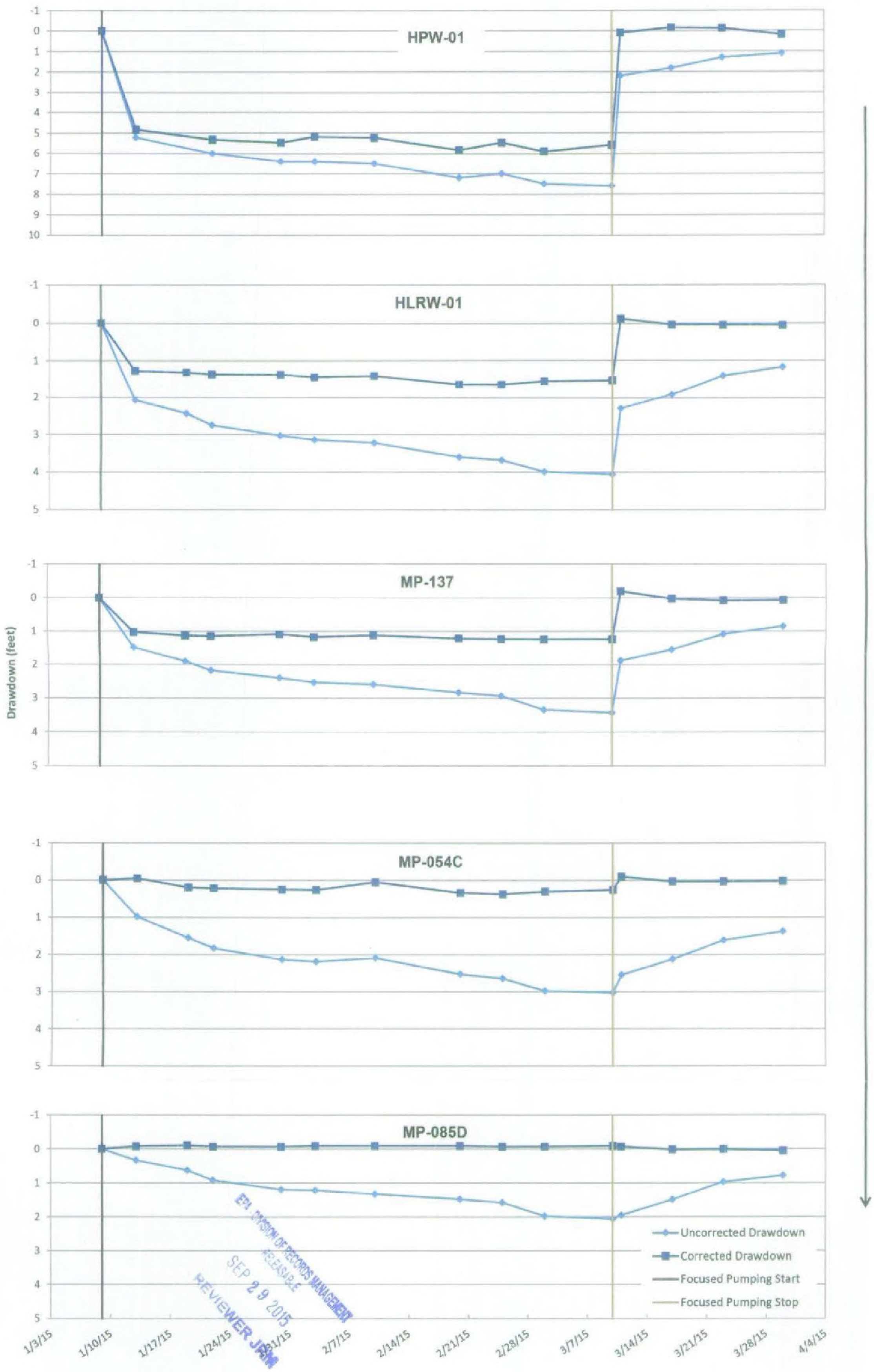
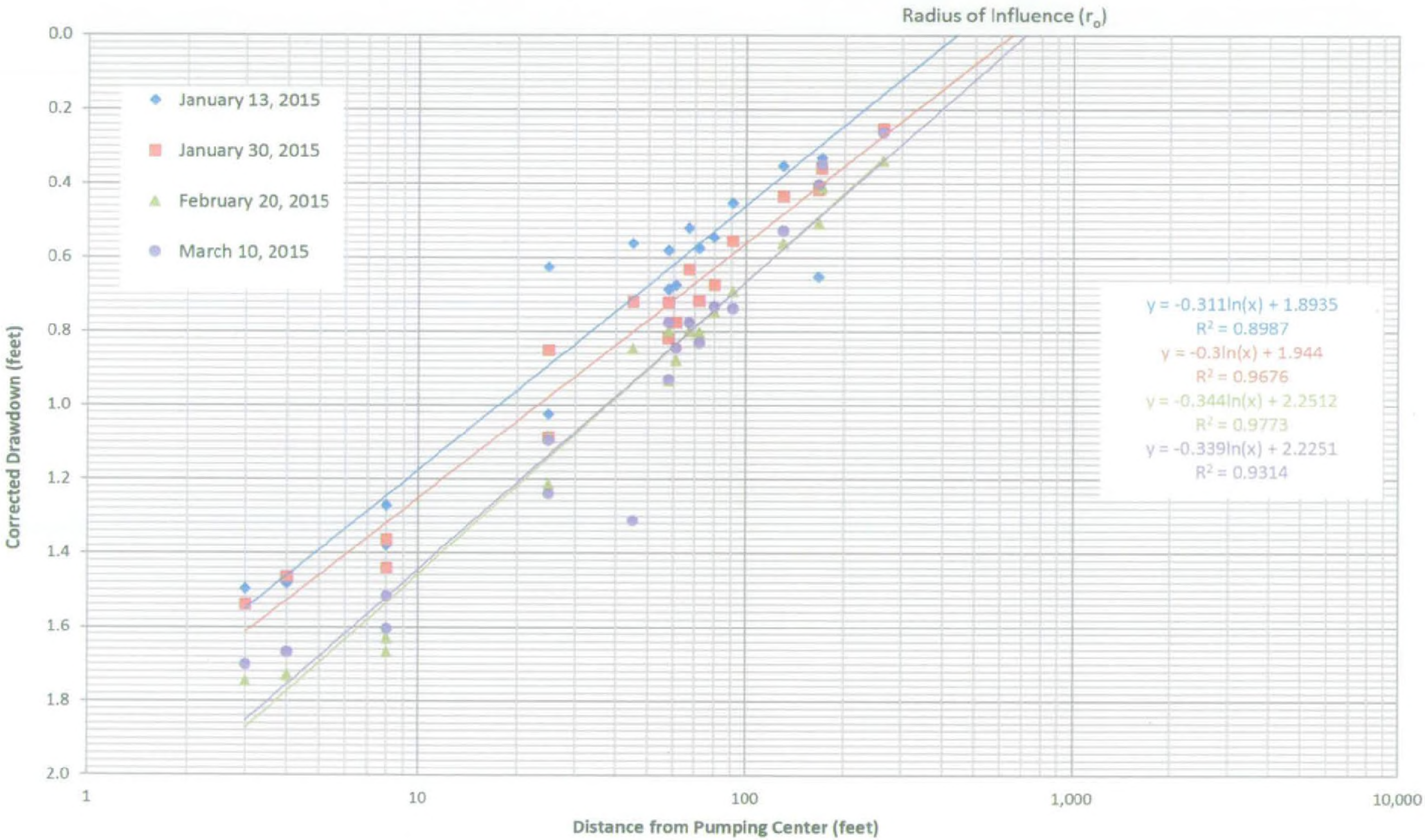
FIGURE 10
POTENTIOMETRIC SURFACE MAP MAIN SAND HYDROSTRATIGRAPHIC UNIT (MARCH 2015)
HARTFORD PETROLEUM RELEASE SITE HARTFORD, ILLINOIS
Drawn By: BR
Checked By: TA
Scale: 1" = 200'
Date: 7/2/15
File: Fig14_AOC_1Q15_Sand.mxd

FIGURE 11. UNCORRECTED AND CORRECTED DRAWDOWN FOR SELECT MONITORING LOCATIONS
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



201506-11_Corrected-UncorrectedDrawdown_FIG-11

FIGURE 12. CORRECTED DRAWDOWN VERSUS DISTANCE FROM PRODUCTION WELL HPW-01
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



201506-12_CorrectedDrawdownVsDistance_FIG-12

EXPLANATION

HPW-01 GROUNDWATER PRODUCTION WELL	LIGHTER-RANGE PETROLEUM HYDROCARBON	GROUNDWATER ELEVATION PRIOR TO PUMPING (JANUARY 9, 2015)
AREA A	HEAVY-RANGE PETROLEUM HYDROCARBON	GROUNDWATER ELEVATION AT MAXIMUM DRAWDOWN (MARCH 9-10, 2015)

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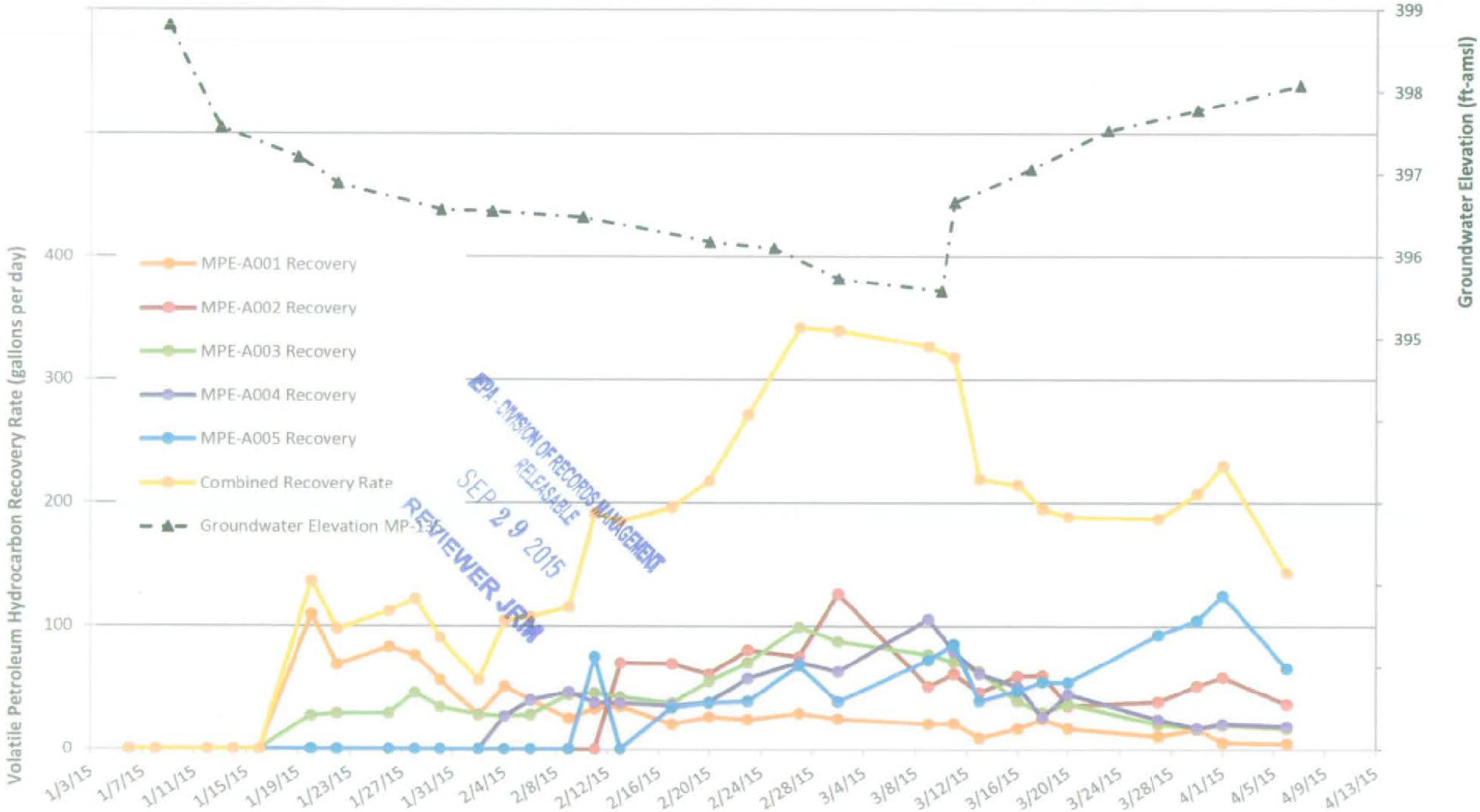
DRAFT

FIGURE 13
LITHOLOGIC SECTIONS INDICATING GROUNDWATER ELEVATION AT MAXIMUM DRAWDOWN AND LNAPL MORPHOLOGY

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

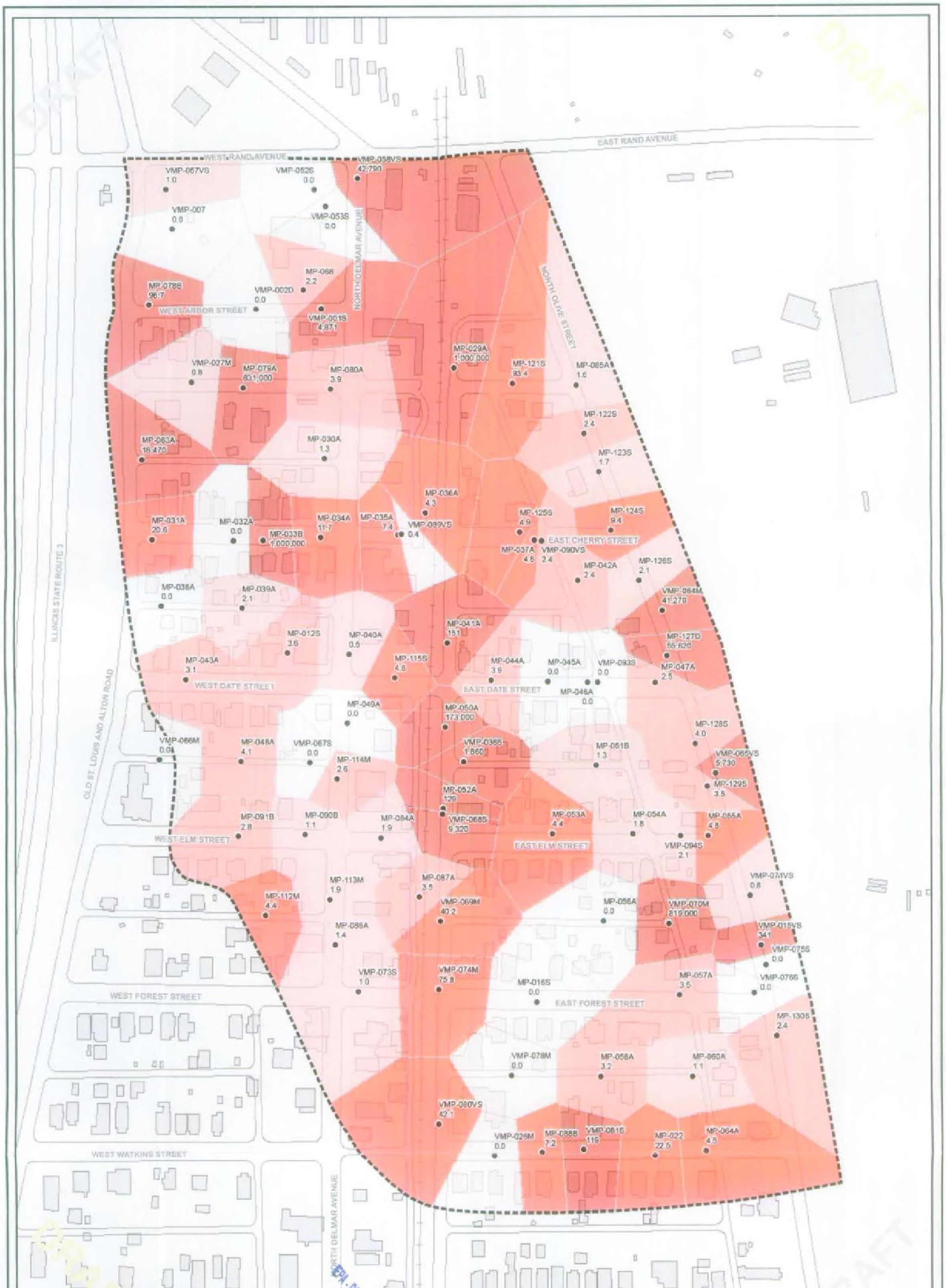
Drawn By: JGP	Checked By: PM	Scale: AS SHOWN	Date: 7/24/15	File: 24S_DRAWDOWNXSECS

FIGURE 14. VOLATILE PETROLEUM HYDROCARBON RECOVERY RATE COMPARED TO HYDROGRAPH FOR MONITORING POINT MP-135
HARTFORD PETROLEUM RELEASE SITE, HARTFORD, ILLINOIS



Note: Increased cumulative vapor recovery between March 30 and April 2 attributed to higher flow rates measured within well MPE-A005 following installation of Venturi flowmeter

201506-14_VaporRecoveryVsGWElevation_FIG-14



EXPLANATION

● SOIL VAPOR SAMPLE LOCATION

TOTAL VOLATILE HYDROCARBON RESULTS RANKED BY QUANTILE

- 1 (0.0 - 0.4)
- 2 (0.5 - 2.1)
- 3 (2.2 - 4.1)
- 4 (4.2 - 93.4)
- 5 (93.5 - 1,000,000)

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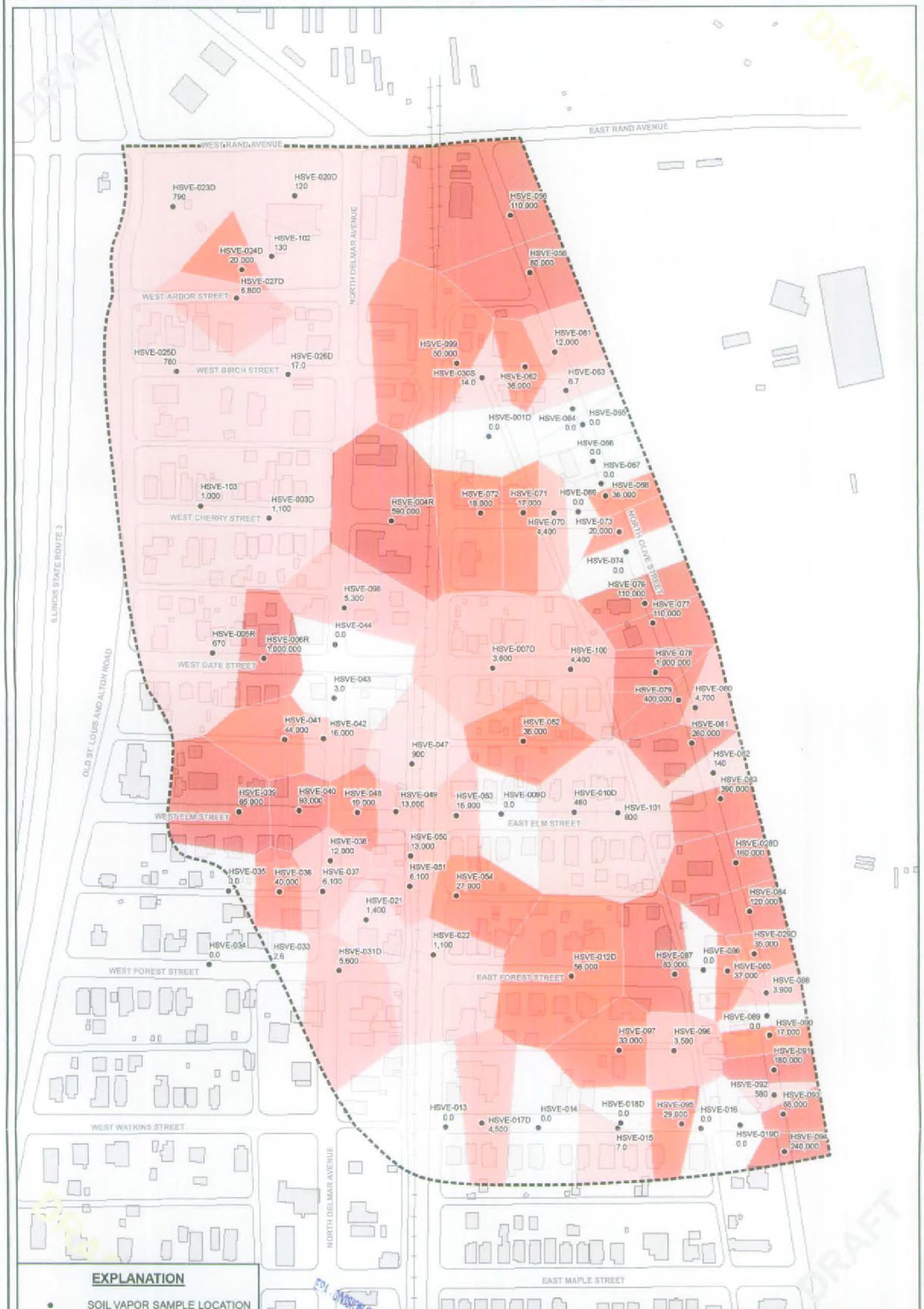
FIGURE 15

RANKED AREAS REPRESENTING TOTAL HYDROCARBON CONCENTRATIONS IN SHALLOW SOIL VAPOR (JANUARY 2015)

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

Drawn By: BR	Checked By: TA	Scale: 1" = 200'	Date: 7/2/15	File: Fig15_VaporRanking.mxd



EXPLANATION

- SOIL VAPOR SAMPLE LOCATION

TOTAL VOLATILE HYDROCARBON RESULTS RANKED BY QUANTILE

- 1 (0.0 - 3.0)
- 2 (3.1 - 1,400)
- 3 (1,400 - 16,000)
- 4 (16,000 - 56,000)
- 5 (56,000 - 1,000,000)

0 200

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FIGURE 16

RANKED AREAS REPRESENTING TOTAL VOLATILE HYDROCARBON CONCENTRATIONS IN VAPOR EXTRACTION WELLS (OCTOBER 2012)

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

Drawn By: BR | Checked By: TA | Scale: 1" = 200' | Date: 7/2/15 | File: Fig16_HSVERanking.mxd

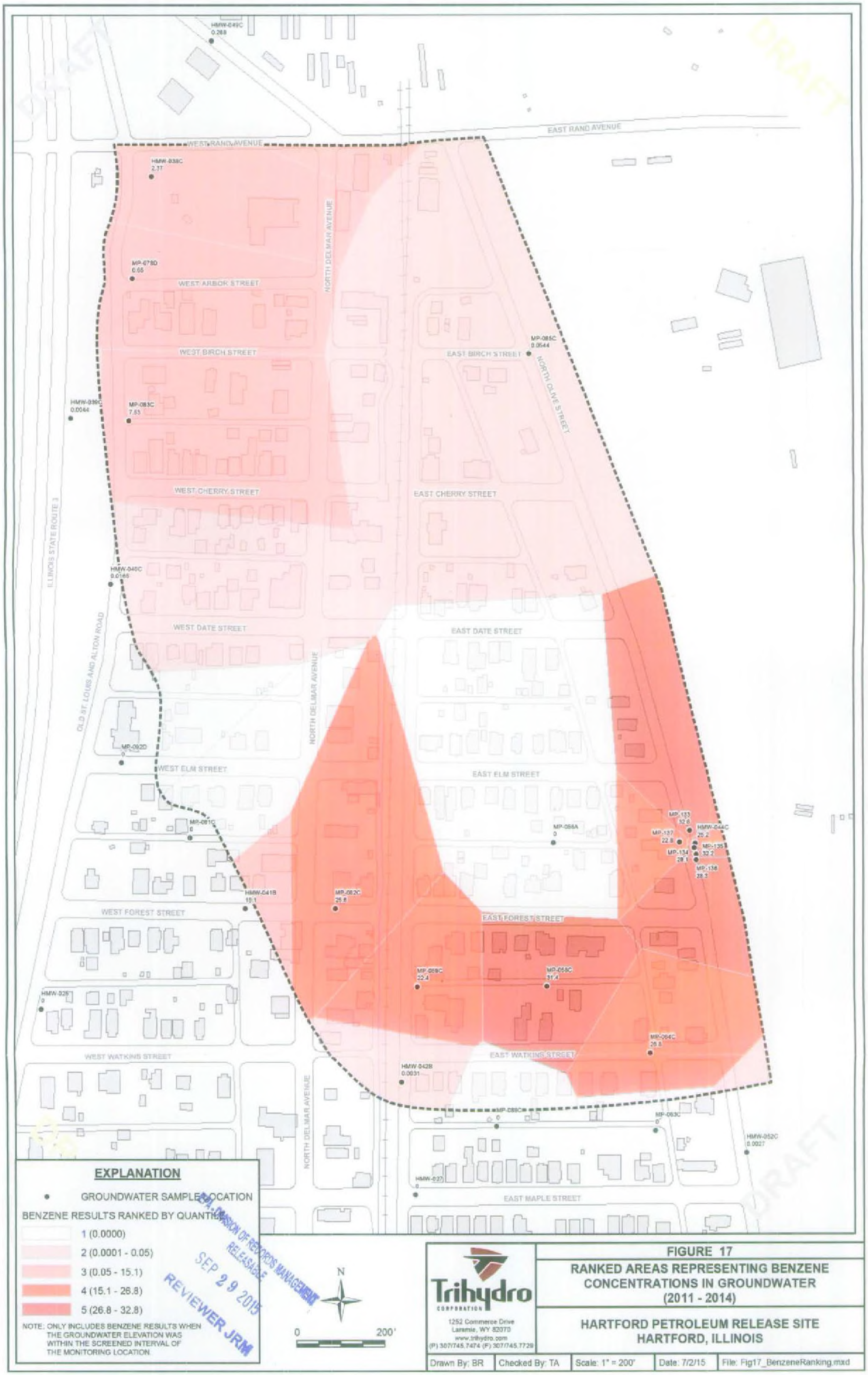
DRAFT
HMW-049C
0.268
EAST RAND AVENUE
WEST RAND AVENUE
HMW-038C
2.31
MP-078D
0.65
WEST ARBOR STREET
NORTH DELMAR AVENUE
WEST BIRCH STREET
EAST BIRCH STREET
MP-085C
0.0544
NORTH OLIVE STREET
HMW-039C
0.0044
MP-083C
7.65
WEST CHERRY STREET
EAST CHERRY STREET
ILLINOIS STATE ROUTE 3
HMW-040C
0.0165
WEST DATE STREET
EAST DATE STREET
OLD ST. LOUIS AND ALTON ROAD
MP-092D
0
WEST ELM STREET
EAST ELM STREET
MP-081C
0
MP-086A
0
MP-133
32.6
HMW-044C
25.2
MP-137
22.8
MP-135
32.2
MP-134
28.1
MP-136
28.3
HMW-041B
15.1
MP-082C
25.8
WEST FOREST STREET
EAST FOREST STREET
MP-089C
22.4
MP-058C
31.4
HMW-026
0
MP-084C
26.8
WEST WATKINS STREET
EAST WATKINS STREET
HMW-042B
0.0031
MP-080C
0
MP-093C
0
HMW-052C
0.0027
HMW-027
EAST MAPLE STREET
EXPLANATION
GROUNDWATER SAMPLE LOCATION
BENZENE RESULTS RANKED BY QUANTILE
1 (0.0000)
2 (0.0001 - 0.05)
3 (0.05 - 15.1)
4 (15.1 - 26.8)
5 (26.8 - 32.8)
NOTE: ONLY INCLUDES BENZENE RESULTS WHEN THE GROUNDWATER ELEVATION WAS WITHIN THE SCREENED INTERVAL OF THE MONITORING LOCATION.
N
0
200'
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FIGURE 17
RANKED AREAS REPRESENTING BENZENE CONCENTRATIONS IN GROUNDWATER
(2011 - 2014)
HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS
Drawn By: BR
Checked By: TA
Scale: 1" = 200'
Date: 7/2/15
File: Fig17_BenzeneRanking.mxd
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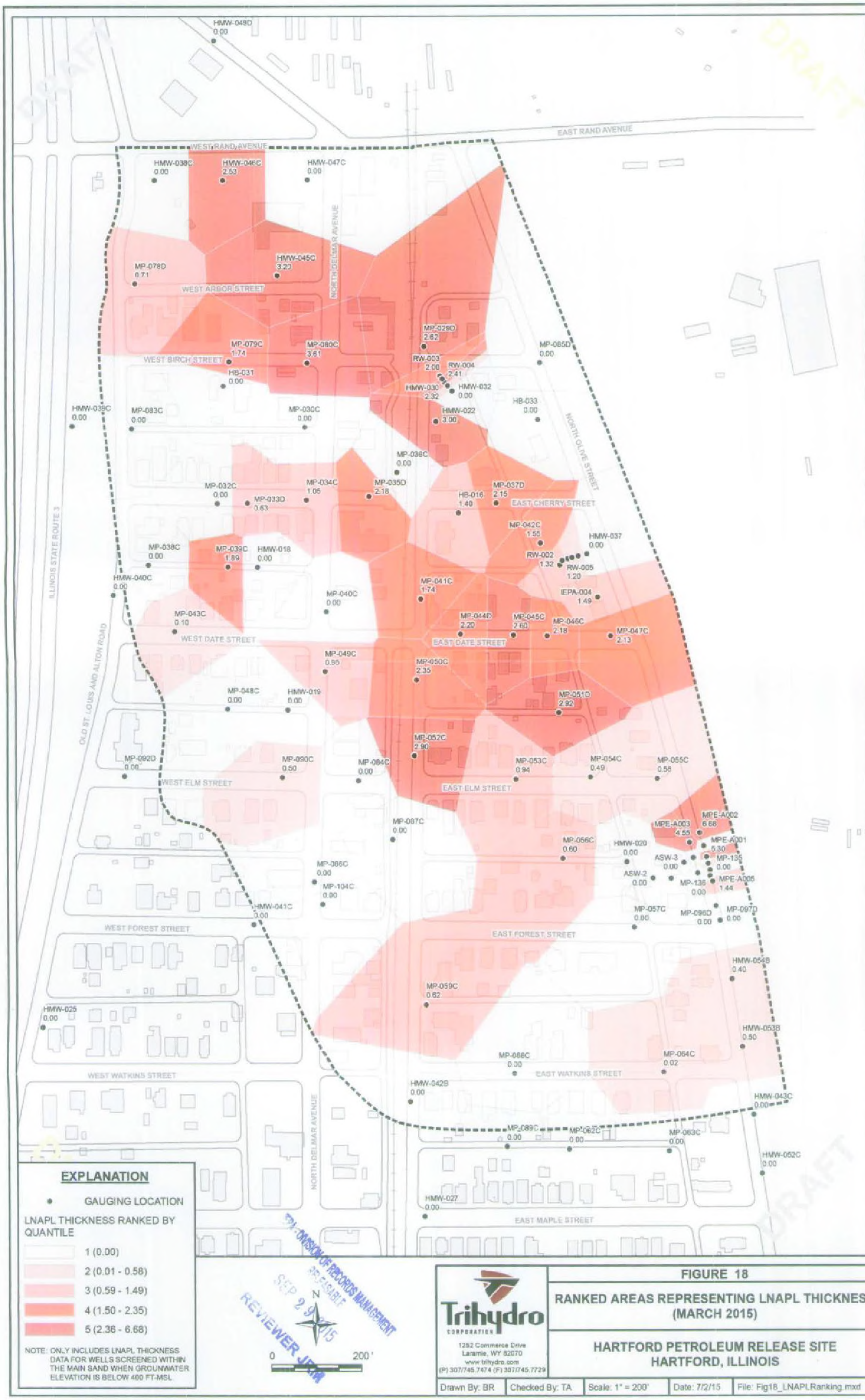

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FIGURE 18

RANKED AREAS REPRESENTING LNAPL THICKNESS (MARCH 2015)

HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS

Drawn By: BR	Checked By: TA	Scale: 1" = 200'	Date: 7/2/15	File: Fig18_LNAPLRanking.mxd

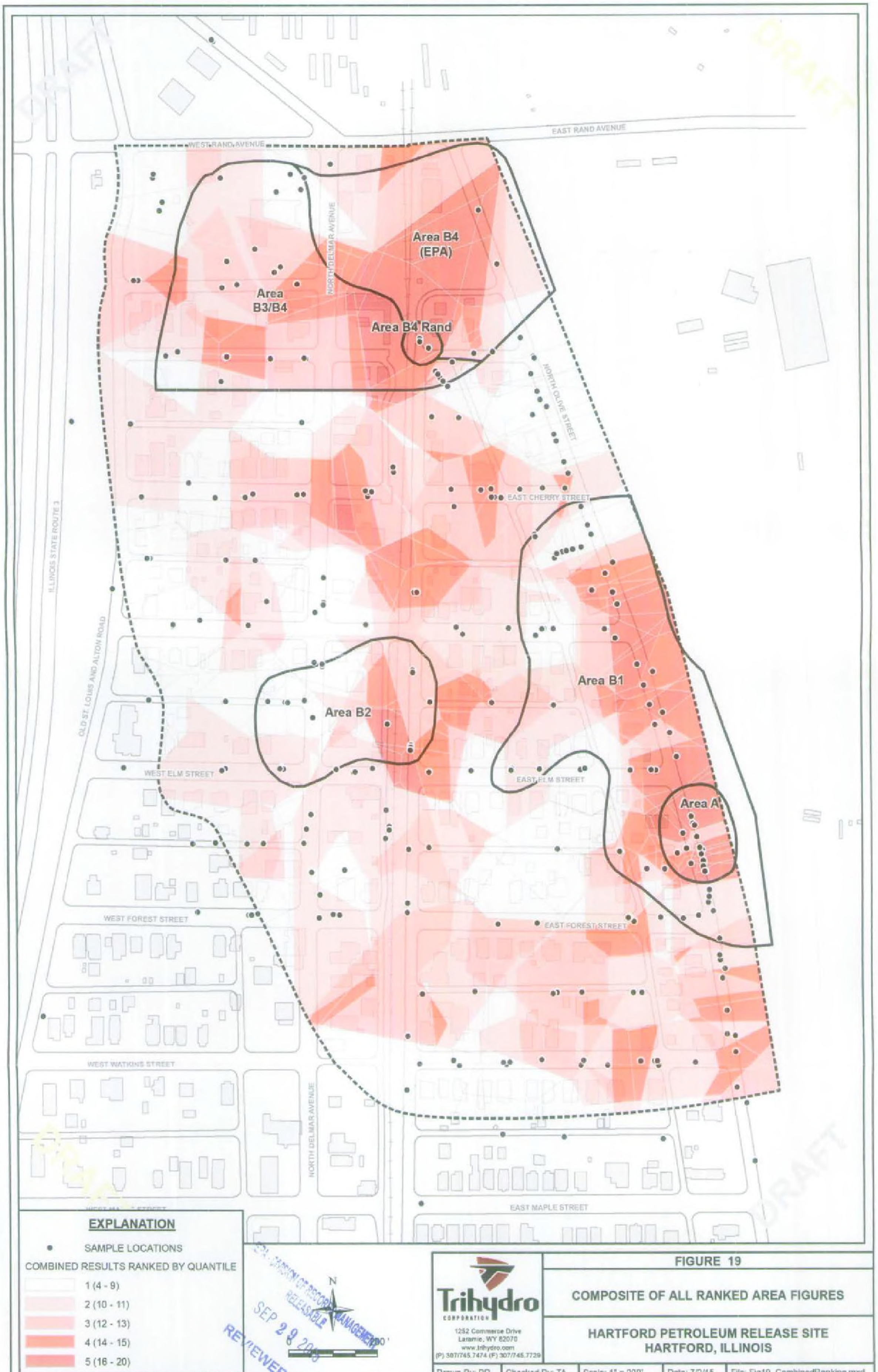
DRAFT
WEST RAND AVENUE
EAST RAND AVENUE
NORTH DELMAR AVENUE
Area B4
(EPA)
Area
B3/B4
Area B4 Rand
NORTH OLIVE STREET
EAST CHERRY STREET
ILLINOIS STATE ROUTE 3
OLD ST. LOUIS AND ALTON ROAD
Area B1
Area B2
WEST ELM STREET
EAST ELM STREET
Area A
WEST FOREST STREET
EAST FOREST STREET
WEST WATKINS STREET
EAST MAPLE STREET
EXPLANATION
SAMPLE LOCATIONS
COMBINED RESULTS RANKED BY QUANTILE
1 (4 - 9)
2 (10 - 11)
3 (12 - 13)
4 (14 - 15)
5 (16 - 20)
N
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FIGURE 19
COMPOSITE OF ALL RANKED AREA FIGURES
HARTFORD PETROLEUM RELEASE SITE
HARTFORD, ILLINOIS
Drawn By: BR
Checked By: TA
Scale: 1" = 200'
Date: 7/2/15
File: Fig19_CombinedRanking.mxd
REVIEWER JRM

APPENDICES A THROUGH I

(PLEASE SEE ATTACHED CD)

A. WELL COMPLETION CONSTRUCTION DIAGRAMS FOR PIEZOMETERS

B. PIEZOMETER BORING ANALYTICAL REPORTS

C. ILLINOIS EPA DIVISION OF WATER MODIFIED PERMIT OF CONSTRUCTION/OPERATION APPROVAL (PERMIT NO. 2014-EE-58312-1)

D. TEMPORARY TREATMENT SYSTEM COMPLIANCE ANALYTICAL REPORTS

E. AMBIENT AIR MONITORING ANALYTICAL REPORTS

F. PRESSURE TRANSDUCER MEASUREMENTS

G. AQTESOLV™ AQUIFER TESTING INPUTS AND RESULTS

H. LNAPL BAILDOWN MONITORING RESULTS AND LNAPL DISCHARGE VERSUS DRAWDOWN

I-1. DISSOLVED PHASE MONITORING FIELD FORMS

I-2. DISSOLVED PHASE MONITORING ANALYTICAL REPORTS

BOL REFERENCE SHEET --- SAME FACILITY

Facility Number: 1190505040

Facility Name: Hartford Free Hydro Carbon Plume

USEPA Number:

File Category: Compliance

FOR ADDITIONAL INFORMATION ON THIS, SEE CATEGORY 08/CD UNDER THIS SAME FILE HEADING.

DATE OF OTHER DOCUMENT	DESCRIPTION OF OTHER DOCUMENT
09/10/2015	Area A LNAPL Recovery Pilot test Summary Report

IL 532 1596
LPC 258 Rev. Jun-93

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